

Popular Science

Monthly

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1872



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FEBRUARY See Page 68 25 CENTS

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Try Any Wurlitzer Instrument in Your Own Home

You may now have any Wurlitzer instrument for an ample free trial in your own home. Examine the instrument, show it to your friends, play it as much as you wish. No obligation to buy—no expense for the trial. We make this liberal offer because we want you to see for yourself the superior quality of Wurlitzer instruments. Skilled musicians praise them for unusual tone quality, artistic workmanship and ease of playing. They are used in the finest bands and orchestras throughout the country. Wurlitzer instruments are the result of 30 years' experience in musical instrument building.

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The greatest musical catalog ever published! Over 3,000 articles—every known instrument described and illustrated; many of them shown in full colors. Gives you lowest prices and all details of Free Trial, Easy Payment plan. All sent FREE—no obligation. Send the coupon today!

THE RUDOLPH WURLITZER CO., Dept. 1112

120 W. 42nd St., New York 111 E. 4th St., Cincinnati

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Send me, absolutely free, your new illustrated catalog, with prices and description of every known musical instrument.

Allow me time to try any needed instrument in my own home and pay for it in small monthly sums. No obligation.

Name _____

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Please enclose postage to which you are entitled.

FERGUSON

IN MANY receivers one may experience excellent "tone quality." With FERGUSON you are conscious of something more: a degree of fullness that gives you each note from every instrument in perfect timbre. Not mere music, but the soul of the artist seems to come into your living room.

One Tuning Control—Calibrated in Meters gives you, in a moment, the program to suit your mood.

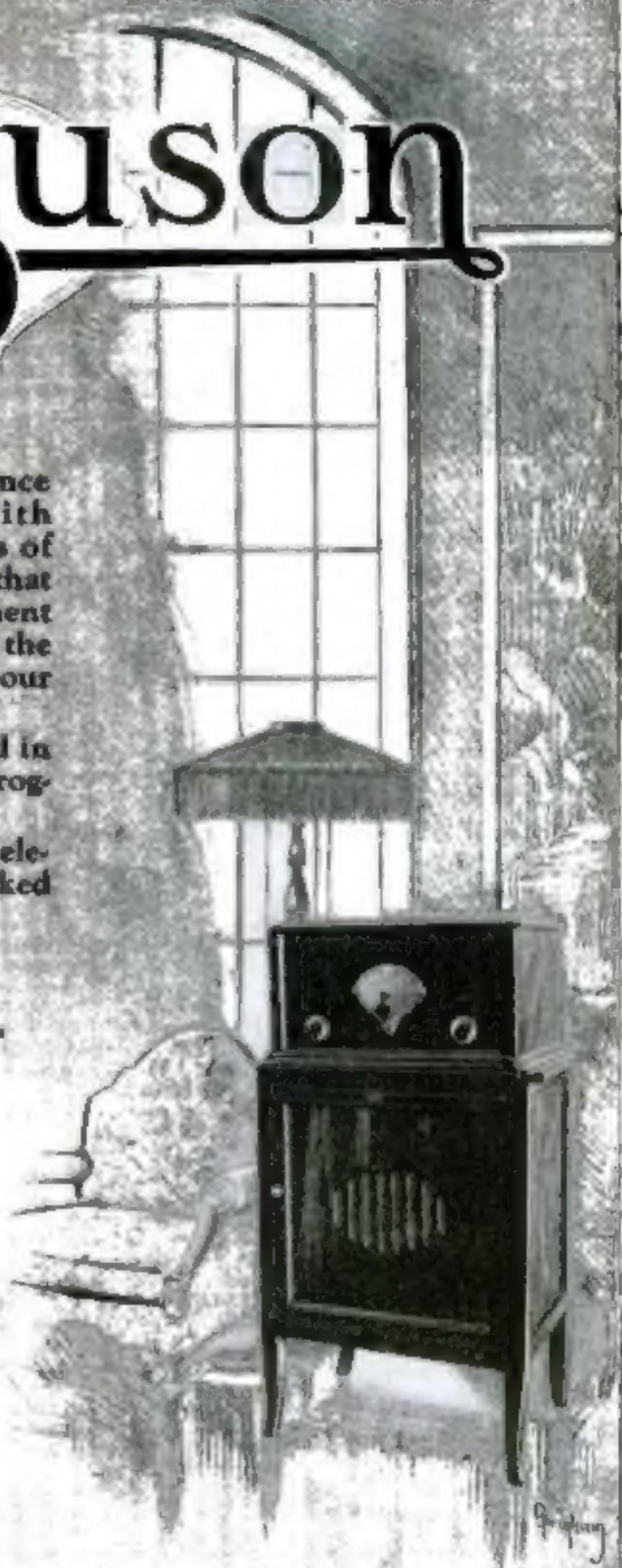
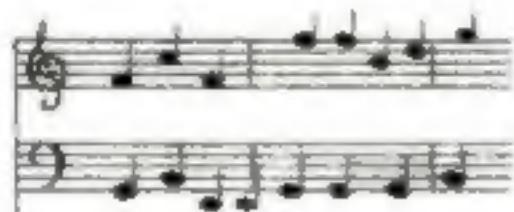
Complete shielding of all tuning elements gives this 6-tube Receiver its marked selectivity.

See, hear, compare!

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225 West 57th Street
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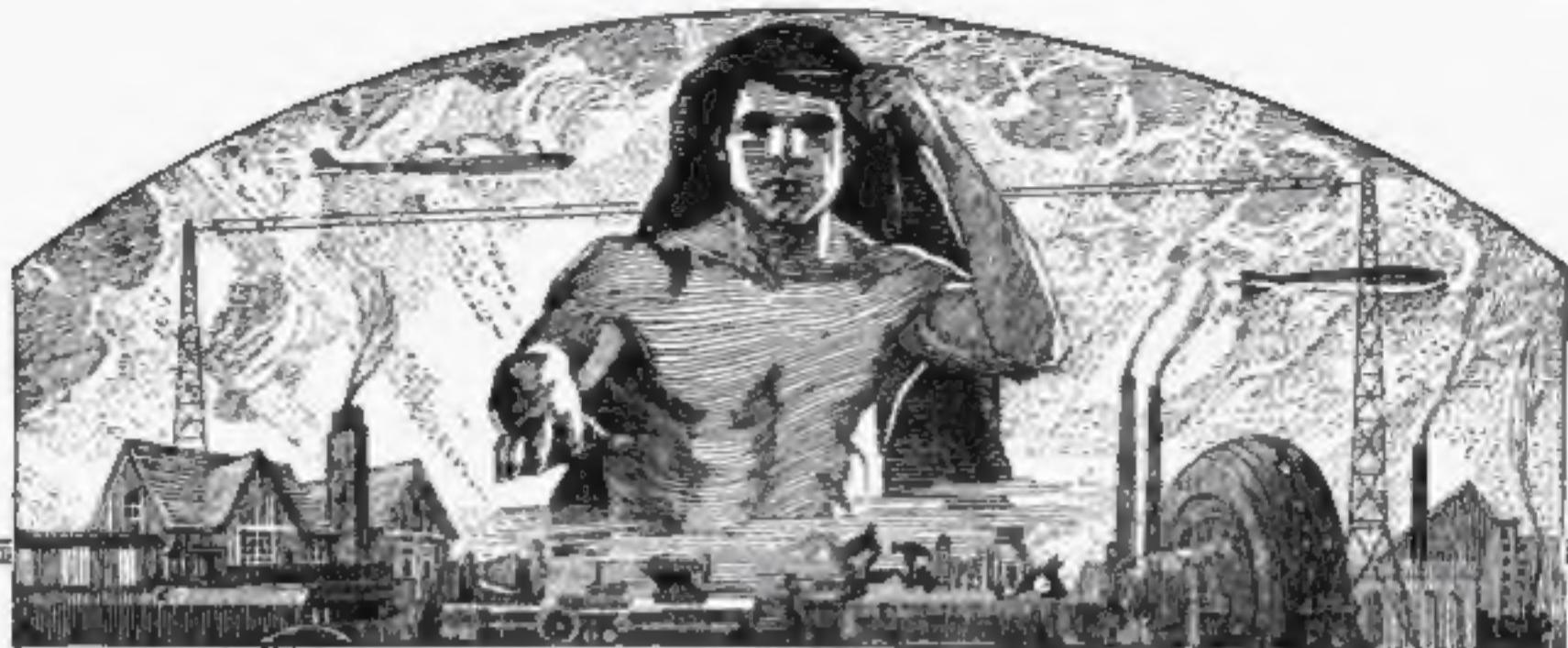
The FERGUSON
Model Ten \$110.00
With table, ashtray, 147.50
(Ten per cent increase west
of the Rockies)



No Seasonal Models—
Continually Developing Refinements

The Gold Standard of Radio Receivers •





FICTION—NEXT MONTH IN THIS MAGAZINE

IN 1872, Edward Livingston Youmans, the blind genius who founded POPULAR SCIENCE MONTHLY, told the readers of this magazine that "the growing importance of scientific knowledge to all classes of the community calls for increasingly efficient means of diffusing it."

For fifty-five years, that thought has always been before our editors. That the tremendous drama of science might be made graphic, understandable and interesting to the largest possible number of people, many changes and improvements have been made in the magazine. Each has been made only after thoughtful consideration of the changes in thought, activities and manner of living in the country. Each, in turn, has proved a more efficient means of diffusing scientific information.

And now we take another step forward. Beginning with our next issue, the magazine will be enlarged to include fiction stories. These stories will be in addition to the present contents of the magazine. Accurate scientifically and mechanically, they will offer you a fresh and appetizing way of keeping in touch with progress.

The thought of adding fiction to the contents of POPULAR SCIENCE MONTHLY is not new. Hundreds of readers have suggested it to us in the past. But, despite the advice of our founder, tradition has been powerful. We had never printed fiction and resisted the thought as do most human beings when confronted with a new idea.

THAT was the situation one day last autumn, when a group of writers, editors and other folk were gathered about a table in a little, out-of-the-way New York restaurant. We were discussing the return of a great hunter and naturalist from an African exploring trip. To illustrate the independence and abilities of the African native, he told of a man who, naked and unarmed with weap-

ons or tools, had been sent alone into the jungle. "And in ten days," continued the explorer, "that man returned with conclusive proof that he had provided himself with food and shelter and had killed a lion. I myself saw the spear he had made and with which he had killed the animal. It had an iron tip which the man had made from iron ore!"

As we chatted I fell to wondering if a modern engineer, equipped with his knowledge and nothing else, could bend the forces of nature to serve his needs. One of the group, Hawthorne Daniel, able writer of fiction, thought he could. The more we discussed the idea the more fascinating it seemed. Presented properly, it offered large possibilities of interesting the readers of this magazine. But how to present it? Fiction seemed the logical solution.

MR. DANIEL became so enthusiastic that he announced he was going to build the idea into a novel. "Bare Hands," to begin in our March issue, is the result. It proved so interesting to the editors of this magazine that we broke a convention of fifty-five years' standing. We felt that it presented scientific ideas in a new and fascinating way. And, having hurdled tradition in deciding to publish it, we found the next step—the publication of short fiction—an easy one. And so you will find in our next issue also, "Midge" by Edmund M. Littell. If you know the power of machinery, and the thrill of it, you won't want to miss this story.

These stories and those that are to follow, month after month, will help you translate some of the marvels of science into terms that are personal to you. As I read them, I compared my life with those of the characters described. I wondered if I could do the things the people in the stories did. Perhaps you, too, will find in them this intense personal interest. Read them and then write and tell me your opinion of our innovation.—S. N. B.



Make your radio set a light socket receiver

*with Balkite "B" and the new
Balkite Trickle and High Rate Charger*



Balkite Trickle Charger \$10
With 6-volt "A" batteries can be left on continuous or trickle charge thus automatically keeping the battery at full power. With 4-volt batteries can be used as an intermittent charge. Or as a trickle charger if a resistance is added. Charging rate about .5 ampere. Over 300,000 in use. Price \$10. West of Rockies \$10.50. (In Canada \$15.)



Balkite Combination

Supplies automatic power to both "A" and "B" circuits. Controlled by the filament switch on your set. Entirely automatic in operation. Serves any set now using either 4 or 6-volt "A" batteries and requiring not more than 30 milliamperes at 135 volts of "B" current — practically all sets of up to 8 tubes. Price \$59.50. (In Canada \$83.)

All Balkite Radio Power Units operate from 110-120 volts AC current with models for both 60 and 50 cycles. The new Balkite Charger is also made in a special model for 25-40 cycles.

To enjoy the convenience of operating your radio set from the light socket add the new Balkite "B" and the new Balkite Charger.

Balkite "B"—the proved "B" power supply—eliminates "B" batteries entirely and supplies "B" current from the light socket. The new Balkite "B"-W serves any set of 5 tubes or less requiring 67 to 90 volts; Balkite "B"-X sets of up to 135 volts and 8 tubes (illustrated); Balkite "B"-Y any standard set.

The new Balkite Charger, with both high and low charging rates, combines the advantages of both trickle and rapid charging. At the low rate, on trickle charge, it automatically keeps your "A" battery fully charged, and in effect converts it

Balkite "B"-W \$27.50; "B"-X \$42; "B"-Y \$69; Charger \$19.50, West of Rockies \$20. (In Canada "B"-W \$39; "B"-X \$59.50; "B"-Y \$96; Charger \$27.50.)

*Hear
WALTER DAMROSCH
and the
NEW YORK SYMPHONY
in your own home*

Every other Saturday night a symphony concert. On alternate Saturdays one of Mr. Damrosch's famous piano recitals on the great Wagner Music Dramas. Over stations: WEAF, WEEI, WCR, WFL, WCAE, WSAI, WTAM, WWJ, WGN, WCCO, KSD, WDAP, WOC. Balkite Hour 9 P. M. Eastern (8 P. M. Central Time).

into a light socket "A" power supply. Its high rate provides an ample reserve of power for the largest sets.

Both Balkite "B" and the Balkite Charger are entirely noiseless in operation. Both are permanent pieces of equipment, with no bulbs and nothing to wear out or replace. Other than household current, their first cost is the last. Both are built to conform with the standards of the Underwriters' Laboratories.

Over 700,000 radio sets are already Balkite equipped. Add these two Balkite Units to your receiver now. Then you too will know the pleasure of owning a radio set always ready to operate at peak power. Ask your dealer. Fansteel Products Co., Inc., North Chicago, Illinois.

FANSTEEL
Balkite
Radio Power Units

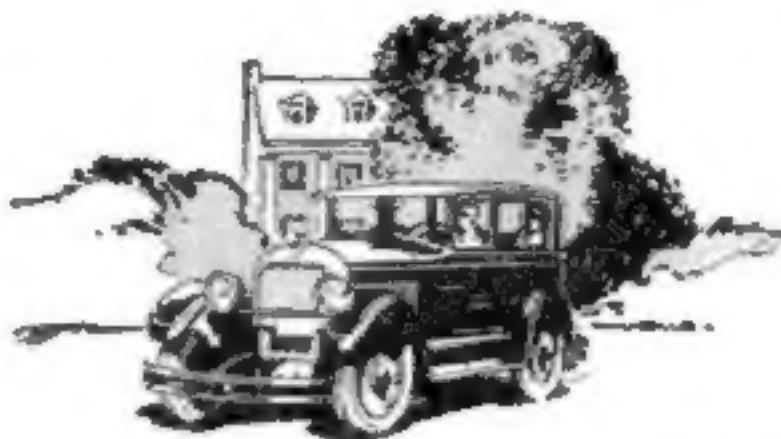
THE BALKITE LINE OF ELECTROLYTIC DEVICES IS PROTECTED BY EDGAR W. THOMAS U. S. REISSUE PATENT NO. 18,488, DATED OCT. 18, 1938



This seal on a radio, test or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Copyrighted material

Every Studebaker has a *second term* under the hood!



Pledge to the Public on Used Car Sales

1 All used cars offered to the public shall be honestly represented.

If a car is suitable only for a mechanic who can rebuild it, or for some one who expects only a few months' rough usage on a camping trip, it must be sold on that basis. Each car must be sold for just what it is.

2 All Studebaker automobiles which are sold as CERTIFIED CARS have been properly reconditioned, and carry a 30-day guarantee for replacement of defective parts and free service on adjustments.

This is possible because enormous reserve mileage has been built into every Studebaker, which is impossible to exhaust in years.

3 Every used car is conspicuously marked with its price in plain figures, and that price, just as the price of our new cars, is rigidly maintained.

The public can deal to confidence and safety only with the dealer whose policy is "one price only—the same price or all." Therefore, we will carry no cars below this limit; every one of them must be honestly priced to begin with.

4 Every purchaser of a used car may drive it for five days, and then, if not satisfied for any reason, turn it back and apply the money paid as a credit on the purchase of any other car in stock—new or used.

It is assumed, of course, that the car has not been damaged by collision or other accident in the meantime.

Not only to the public, but also to The Studebaker Corporation of America, whose cars we sell, we pledge adherence to the above policy in selling used cars.

Your Studebaker Dealer

© 1925, The Studebaker Corporation of America

Used Studebakers like new Studebakers can be bought on the Budget Plan of Payment

STUDEBAKER is the original Second Term Candidate in the world of automobiles, and whoever cannot buy a New Studebaker is safe in buying a used Studebaker.

First, because the excess mileage built into a Studebaker under One-Profit manufacture is sufficient to carry over from one owner to another!

Second, because the dealer who reconditions a Used Studebaker backs his work with a positive Pledge for the re-assurance of the second purchaser!

A Free Book That Will Save You Money

Experts who buy used cars for Studebaker dealers have furnished material for this frank and helpful book.

It tells you what to look for and what to avoid in purchasing a used car. No such valuable guide was ever before offered to the public at any price.

***Send for this
FREE BOOK!***



THE STUDEBAKER CORPORATION OF AMERICA
Department 56, South Bend, Indiana

Please send my copy of valuable free booklet, "How to Judge a Used Car."

Name _____

Street _____

Town _____ State _____

S T U D E B A K E R



more distance on the same set

Want more stations on that storage battery set of yours? Want the far-away ones you get now to come in more easily and regularly? The Radiotron laboratories have developed a *super-detector* that slips right into the socket where you have a Radiotron UX-201-A now. Just change that one to a Radiotron UX-200-A.

It makes your set sensitive to fainter signals—reaches out to farther stations—picks up weaker ones you couldn't get before. It makes a big change for a very small cost!

*Bring your storage battery set up-to-date with
a power RADIOTRON UX-201 or UX-202
and a detector RADIOTRON UX-200-A
and RADIOTRONS UX-200-A for all-round quality.*

*Bring your dry battery set up-to-date with
a power RADIOTRON UX-110
and RADIOTRONS UX-109 for all-round quality.*

RADIO CORPORATION OF AMERICA
New York Chicago San Francisco

HEATING METAL INSIDE OF GLASS

Everyone knows that glass melts easily, and metal requires a high temperature. Yet, at the Radiotron laboratories, the experimenters can put a Radiotron in the coil of a "high frequency furnace" and melt the metal *inside it* without melting the glass. This is done by an electric current that is induced inside the glass bulb, right through the glass.

This extraordinary furnace is not only used for experiment. In manufacture, every single Radiotron goes for a moment through such a furnace, just after the air has been exhausted out of it. The inside metal is heated red hot in the vacuum, and the tiny air bubbles boil right out of the metal and the glass, and are pumped away. Never before could such an exhaust be obtained.

This means *real performance* when the Radiotron gets into your set. And it adds another reason for insisting on a genuine RCA Radiotron with the RCA mark on the base and the glass. There are Radiotrons for every purpose.



RCA-Radiotron

MADE BY THE MAKERS OF THE RADIOLA

"Buy Now, Pay Later"

A Good Way to Make Investments

By WALLACE AMES, *Financial Editor*

OH, HOW I hate the sight of that man," snapped out Mrs. Bullard. And well might she feel that way, for he was the installment collector, and he had a way of showing up almost before the weekly pay envelope was opened.

"A dollar down and a dollar a week" brought that fine set of books into the home. "Buy now and pay later" made it so easy to equip the house with electric fans during the first heat wave of summer. "Your credit is good here" changed the old living room furniture for some nice new chairs and sofa. "It is a pleasure to charge it" put a \$300 fur coat within their means.

Now, POPULAR SCIENCE MONTHLY does not infer that the installment method of buying, which is increasing so rapidly of late, is wrong. But Mrs. Bullard and her family overdid it. Their family income was all spent before it was received. Paying on this and paying on that left hardly a decent sum for daily necessities, and nothing for emergencies. No wonder Mrs. Bullard hated the sight of the installment collector.

But finally the car and the washing machine were paid for. That meant a monthly surplus of \$75 which from now on could be put to some other use. And then a different kind of installment salesman came along—selling bonds, future income, financial independence—on the installment plan. And now the Bullards are getting ahead.

HE SURELY was a good salesman, this man selling independence on monthly payments. His inducements are worth repeating.

"Good morning, Mrs. Bullard. I represent Safe, Security & Company. I have called to sell you a \$500 First Mortgage Bond. It will pay 6% interest which means at least \$20 a

year more to you than you can get on \$500 in the bank."

"I wish we did own some bonds," replied Mrs. Bullard, somewhat wistfully, "but we haven't the \$500, to tell you the frank truth."

"Well, then," the salesman surprised her by saying, "I am in a position to sell you, not one \$500 bond, but many of them, one after another. I can sell you a good, tidy nest egg, real financial independence. And you can pay just as easily as you buy a

buying a bond than to pay for it all at once, that is, if you had to save up the money first and didn't get any interest on it during that time. And as you commit yourself in advance to buy this bond you are pretty sure to go through with the plan, whereas if you just decide to save the same amount of money each month, without this definite obligation, so many things might come up the chances are by next December you would not have the \$500 you started out to get."

HOW TO GET AHEAD

THIS new Department is to help readers in the establishment of proper financial programs at the beginning of their business careers; it assists those who have accumulated money in the proper investment of it so that it will be safe and so that it will grow.

The Editor of this Department is an authority on investment matters and he will not only every month give the readers interesting and useful information in his articles, but is also ready to aid in personal investment problems. Advice will be gladly given regarding the proper investment of funds and proper plans of saving.

Any advertising appearing in this section will be carefully investigated by the Publisher of POPULAR SCIENCE MONTHLY. Readers can be sure that companies advertising are reliable and that they offer securities which represent sound financial investments. While investments obviously cannot be guaranteed by the Publisher, every effort will be made to insure that only advertisements of absolutely reliable companies are accepted.

Address letters to: Wallace Ames, *Financial Editor*, POPULAR SCIENCE MONTHLY, 250 Fourth Ave., N.Y.

piano or an automobile on the installment plan."

"How is that?" Mrs. Bullard inquired, her interest aroused.

"Let's see," continued the salesman, "today is February 1. Our Company will sell you a \$500 bond, to be delivered December 1, ten months from now. You pay \$50 down and we will loan you the balance, holding the bond as security. You pay off the loan at the rate of \$50 a month. We charge you interest on the unpaid portion of the loan, but your bond interest will more than cover it."

"This is actually a cheaper way of

THE installment bond salesman made his sale. And the Bullard family are soon going to be real bond holders. They will not stop with one bond. Bond buying is from now on a definite part of their financial program. They are getting ahead on the installment plan.

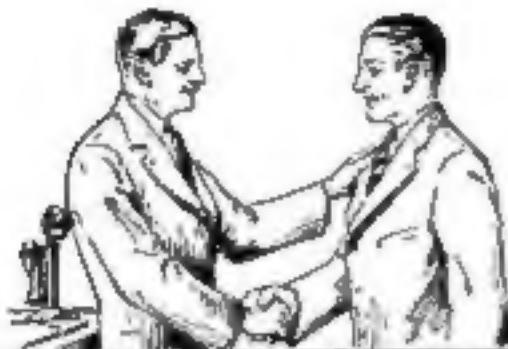
Many investment bankers will sell bonds on the installment or partial payment plan. Their systems differ somewhat in detail, but in principle and in effect they are the same.

It is customary to require a down payment of 10% of the face value of the bond. \$10 on a \$100 bond, \$50 on a \$500 bond, or \$100 on a \$1,000 bond will open an account. Payments thereafter may be made monthly or oftener, and in any amount, but at

least 10% should be paid each month and the bond fully paid for within ten months.

There are many advantages to a partial payment investment account. Perhaps the biggest advantage is that it puts the investor *under obligation to himself*. He is definitely committed to get ahead. It becomes a systematic endeavor instead of a haphazard, well-meant, but poorly executed plan.

The Financial Department of POPULAR SCIENCE MONTHLY would recommend to all its "getting ahead" readers that they consult a reliable investment banker regarding a plan to buy bonds regularly.



FIDELITY MEANS KEEPING FAITH

Trustworthy

Before an individual is admitted to business partnership, his trustworthiness is established.

We suggest that you apply the same principle in selecting a first mortgage real estate bond house. Choose an institution with a proved record of integrity, conservatism and experience. For these determine the true value of your investment and assure safety.

This company invites every prospective purchaser of Fidelity 6½% Guaranteed Bonds to investigate *first* "The House Behind the Bonds." A timely booklet by that name is now ready—write for a copy.

FIDELITY

BOND & MORTGAGE CO.

600 Chemical Bldg., St. Louis
1100 New York Life Bldg., Chicago
378 Colorado Nat'l Bank Bldg., Denver

JOHN HENRY FIDELITY FOUNDED 1873

FIDELITY BOND & MORTGAGE COMPANY

The Most
Thrilling Story You
Ever Read!

BARE HANDS

by

HAWTHORNE DANIEL

A
*Six-Part Novel
of Adventure
and Achievement
in the Far North*

Beginning
Next Month

in

POPULAR SCIENCE MONTHLY

Booklets That Will Help You Get Ahead

ANYONE with money available for investments will find the booklets listed below of help in getting ahead financially. You may obtain any of these booklets by writing direct to the issuing house. It will be appreciated if you will mention POPULAR SCIENCE MONTHLY when writing for booklets.

How to Build an Independent Income (1927 Edition)—Describes a plan for buying 6½% First Mortgage Bonds by payments of \$10 or more a month, and shows the results that may be accomplished by systematic investment at 6½%. For copies address: The F. H. Smith Company, Smith Building, Washington, D. C.

"Diversification and Vigilance" presents a brief analysis of seven basic principles that assure success in the management of personal investments. Address: A. B. Leach & Co., 57 William Street, New York, N. Y.

"WHAT You SHOULD Know about First Mortgage Bonds" tells about real estate bonds, their safety and how they will increase your income. Address: Adair Realty & Trust Co., Healey Building, Atlanta, Ga.

"Fifty-Four Years Without Loss to Any Investor" presents the safety record of this house and describes the safeguards constituting the Straus Plan. Address: S. W. Straus & Co., Desk P, Fifth Avenue & 46th Street, New York, N. Y.

"SAFE Bonds for Investment" presents their current list of diversified investment offerings, with instructive investment comment. Address: Halsey, Straus & Co., 201 South La Salle St., Chicago, Ill.

Ten Making of a Good Investment explains the methods employed by the United States Mortgage Bond Co. in originating first mortgage bond issues which pay 6½% with principal and interest guaranteed, or 6½% without the guarantee, which is optional with the investor. Address: United States Mortgage Bond Company, 607 Shelby Street, Detroit, Mich.

How to Grow and Harvest Dollars describes a saving-investment plan offered by that Company, and describes how to accumulate from \$4,602.23 to \$46,032.47 by monthly investments of from \$10 to \$100. Address: H. O. Stone & Co., Stone Building, Chicago, Ill.

An Investment Insured for Its Lifetime describes a plan of insured mortgage investments. Nine points of safety are explained. Address: Mortgage Security Company of America, Camp & Canal Streets, New Orleans, La.

Rules for Safe Investments explains in language that the layman can understand the important factors of safety of real estate bonds. Address: American Bond & Mortgage Company, 345 Madison Avenue, New York, N. Y., and ask for Booklet P. S. 40.

Buying Bonds by Mail explains how the investor may safely and conveniently deal with an investment banker through the mails, and without the usual advantage of direct contact. Address: A. G. Allyn and Company, 67 West Monroe Street, Chicago, Ill.

Your Money covers the points of general interest to the investor who is planning to put his money in sound mortgage bond investments. Address: Fidelity Bond and Mortgage Co., 39 South La Salle St., Chicago, Ill.

How to Analyze a First Mortgage Real Estate Bond Issue is the self-descriptive title of a booklet published by the Federal Bond & Mortgage Co., Griswold & Clifford Avenues, Detroit, Mich.



**6½% on \$10 a month or
\$2% \$10,000 or more**

THE safety of Smith Bonds lies in the essential character of their basic security—modern well-located apartment buildings and office buildings in important cities of the eastern United States.

As long as these large cities exist, there will be a demand, in good localities for large buildings in which to live and to do business. Such properties produce constant and substantial incomes, and give lasting protection to investors in First Mortgage Bonds. The F. H. Smith Company's record—

No Loss to Any Investor in 54 Years

—is due, largely, to the policy of accepting only conservative first mortgages on high-grade properties, occupying choice sites in safe cities.

Current offerings of Smith Bonds, in \$1,000, \$500 and \$100 denominations, pay 6½%. State and Federal tax provisions increase the yield.

Invest Your Savings Under This Plan

For men and women of moderate means, and others who wish to invest as they save, our Investment Savings Plan offers the opportunity to buy 6½% Smith Bonds by payments of \$10, \$20, \$30, \$40, \$50 or more a month. Regular monthly payments earn the full rate of bond interest—6½%.

Mail the form below for the 1927 edition of our booklet, "How to Build an Independent Income," which shows how your money will grow at 6½%, and for our new, illustrated booklet, "Fifty-four Years of Proven Safety."

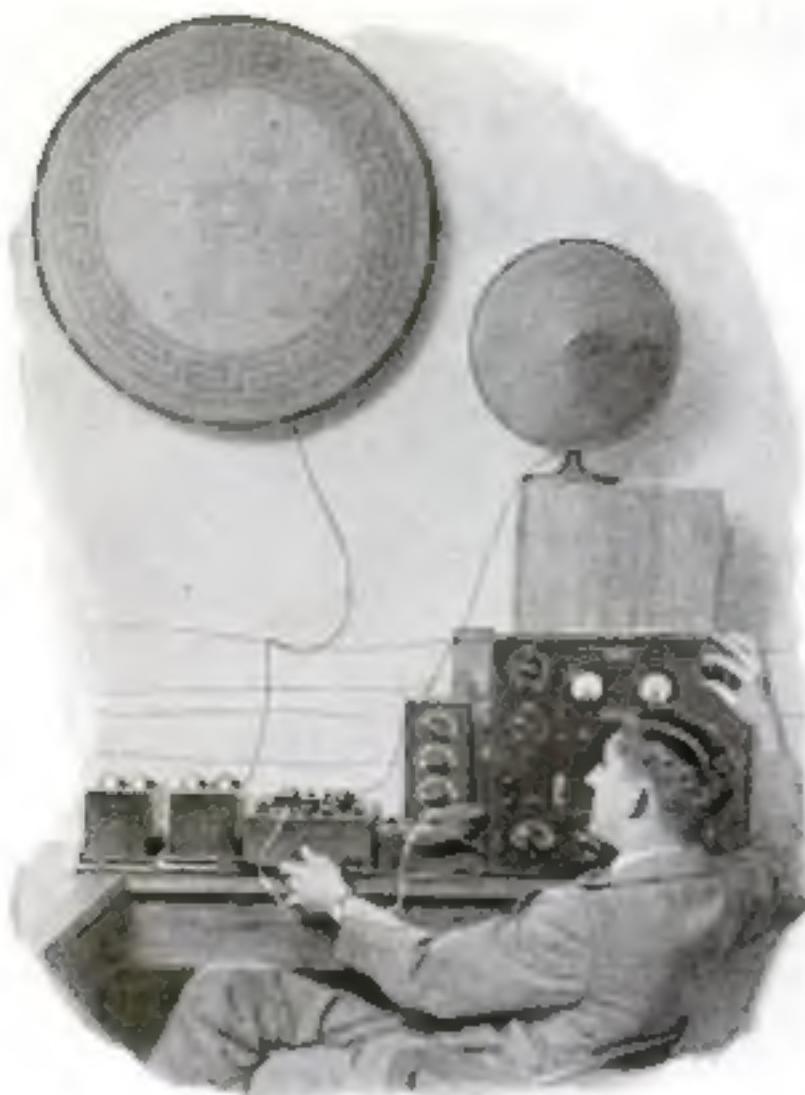
The F. H. SMITH CO.

FOUNDED 1873

SMITH BUILDING - WASHINGTON, D. C.
205 MADISON AVENUE - NEW YORK, N. Y.

PITTSBURGH BOSTON PHILADELPHIA
BUFFALO ALBANY MINNEAPOLIS

Name _____ 74-11
Address _____



HAVE you heard that new loudspeaker Morrison has? I understand it's got it all over most speakers. Was thinking of getting one like it for myself—mine's nothing to brag about." Another radio fan who is more or less dissatisfied with his speaker and looking for one that will give the reception he wants.

It may be that the speaker his friend is so pleased with will give him satisfaction, too, but not necessarily so. The degree of satisfaction which a speaker will give is dependent on a good many considerations—many more than are involved in buying any other radio accessory or even a receiving set. Furthermore, most of them are entirely outside of the speaker itself.

In the first place, the very wide differences in individual tastes and the still wider differences in the hearing sense of individuals leave the term "satisfactory operation," as applied to loudspeakers, open to many definitions.

So that, even if all receiving sets had exactly the same reproducing characteristics for the realization of a maximum enjoyment, each of us would require loudspeakers of different characteristics. And the fact that receiving sets differ widely in their response characteristics, and that even our broadcasting stations show decided departure from perfect sound transmission, makes it impossible to name one speaker, or several speakers, that will give satisfaction in every case.

You can take a loudspeaker that is the closest approach to perfection, connect it up to an imperfect receiver, or tune-in when the broadcasting is

Are You SATISFIED *with Your* LOUDSPEAKER?

A APPARATUS set-up used by the Popular Science Institute for determining the relative frequency response characteristics of loudspeakers

By
ALEXANDER SENAUKE, E.E.
Radio Engineer
Popular Science Institute of Standards

imperfect, and the resulting reception will be far from natural.

It may be that the set our dissatisfied loudspeaker owner is using is inferior in tone reproduction to his friend, Morrison's. Or, too, it may be that his taste and hearing senses differ from the other man's. The result will be that, when he buys the speaker that is giving his friend such satisfaction, he may fail to find anything so wonderful about it, and will continue his search until he comes across a speaker that matches up with his requirements. It is quite possible that his final satisfactory choice will be a speaker that is somewhat inferior to his friend's. A slightly muffled tone will cover up the deficiencies in his set, or a peculiarity in his taste or hearing will make him like certain qualities in the speaker that would

be displeasing to another listener.

It follows, therefore, that the final choice of a loudspeaker can best be made by the individual purchaser and should be based on a demonstration on his own or equivalent receiving equipment. To eliminate from consideration (1) speakers whose characteristics are such as to make them unsatisfactory for use under any conditions, and (2) speakers that show faults that may not appear on any single dealer demonstration, the prospective loudspeaker purchaser can consult and limit his investigations to those loudspeakers on the approved list of the Popular Science Institute.

FURTHERMORE, a choice of a speaker approved by the Institute assures the purchaser that it possesses:

1. An efficiency consistent with its type and price.
2. A power output handling capacity expected of speakers of its class.
3. Sound mechanical and electrical design.

4. A quality of material and construction that will insure long trouble-free operation.

These points are all determined by the Popular Science Institute by means of accurate laboratory tests. With all outside considerations eliminated, the Institute is able to definitely pass judgment on speakers as individual units in themselves, disregarding the personal factors which must be left to the individual purchaser.

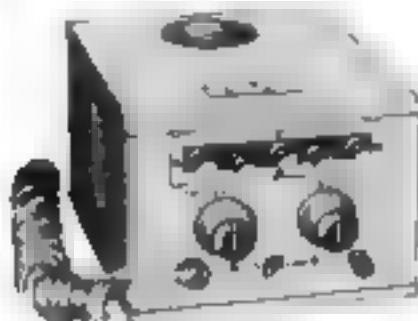
A list of approved radio products can be secured from the Popular Science Institute, 250 Fourth Avenue, N.Y.C.

Popular Science Monthly GUARANTEE

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY. THE PUBLISHERS

Hermetically Sealed!



*The last word
in socket power*

ALL-AMERICAN Battery Eliminator

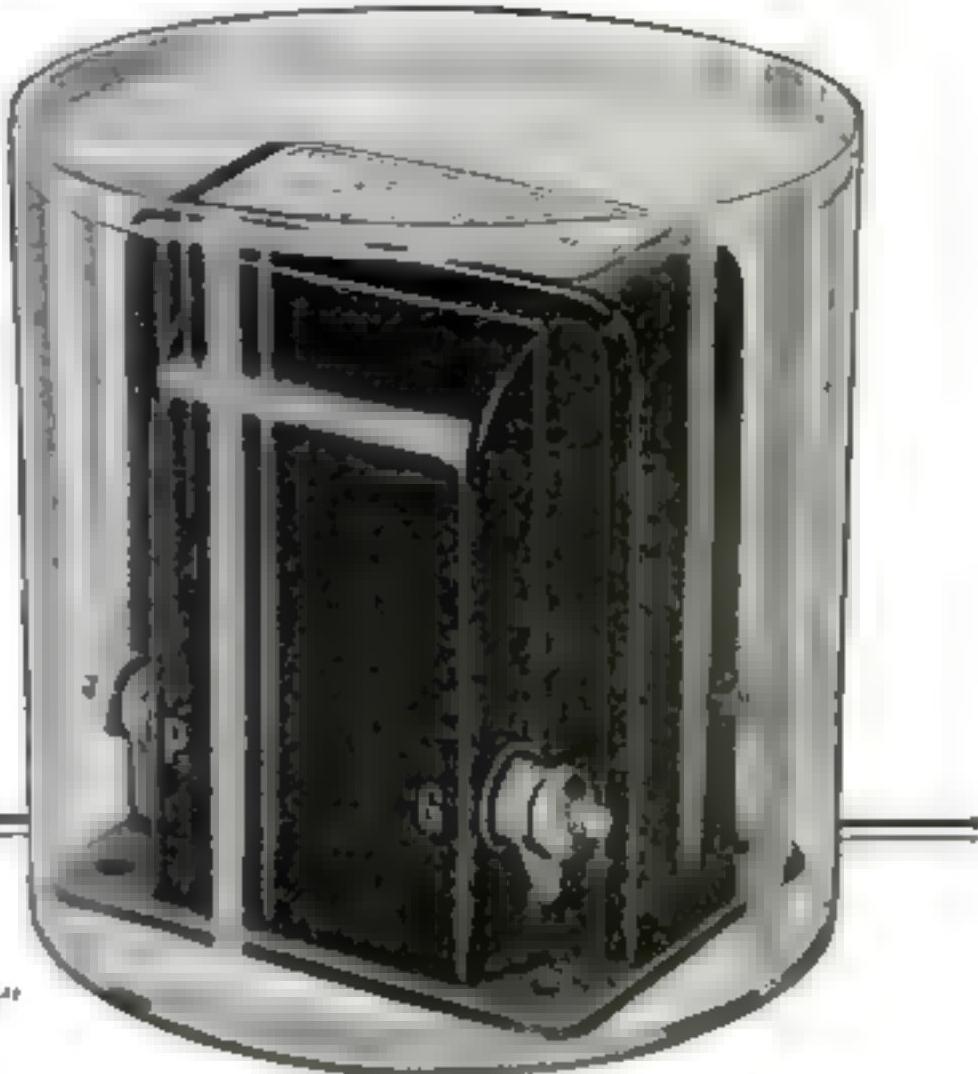
Attach it to the nearest light socket and you have a dependable, unvarying supply of uniform plate current. Five taps of different voltages, a Detector control, and a High-Low switch provide absolute control of voltage for any requirement. Compact, handsome, and the name All-American is your guarantee of the utmost in quality.

Price \$37.50
Complete with Raytheon Tube



New 1927 Radio Key Book

You'll enjoy reading it—48 pages of interesting, up-to-the-minute facts about radio, simply told. Also full construction details of all leading types of circuits. Send 20 cents (coin or stamps) to cover postage and mailing cost.



ALL-AMERICAN AUDIO TRANSFORMER

After being submerged in water for more than a month, this All-American Audio Transformer performed *perfectly*.

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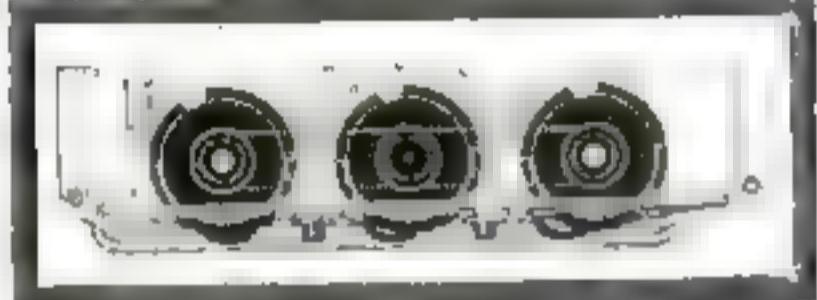
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TRADE MARK REG. U. S. PAT. OFF.



POPULAR SCIENCE MONTHLY

SUMNER N. BLOSSOM, Editor

February, 1927



Blowing Out the



M. M. Kinley, of Tulsa, Okla., whose expert methods have put out more than a thousand oil well fires, and who has been called the "modern舜" of modern romance.

A HERE it plume of orange flame, towering and spattering, waves against the black sky. Rising from an open field, it shoots higher than a ten-story building. A burning mountain of smoke rolls and heaves toward the horizon.

An Oklahoma oil gusher is afire.

Wires, flickering reflections light many acres around. Far back from the blaze, but with the glare bright in their faces, a crowd of spectators and workmen stand, held at bay by the scorching heat. They watch intently.

Inside the deadline, close to the flame, a figure is moving. It is a man clothed in white, a spectral form, seeming to hover almost at the foot of the column of fire amid the smoking, glowing debris of what was once a ninety-foot derrick.

Finally the figure turns and comes

Biggest GAS JETS in the World

How the Strange Firemen of the Oil Fields Do Their Jobs with Deadly Explosives

By JESSE F. GELDERS

toward the crowd. Its hands and feet, encased in white, look grotesquely large. Heavily hooded, its face is invisible, except through a small transparent aperture for the eyes.

Workmen gather around. The hood is lifted off and a man stands there, red and perspiring.

He is M. M. Kinley of Tulsa engaged at his regular business of extinguishing oil and gas well fires. He has put out more than three dozen by a spectacular method. He blows them out. The trick is that instead of blowing with his lungs, he uses a blast of gelatinized nitroglycerine.

There is a brief conference, a warning of workmen, the cry of "Get back, now! Get back everybody!"

They draw away. The white hood is in place again. It is asbestos. So is the whole garment from the shoe soles up, all except the eye slot, which is mica. Glass would crack from the heat.

Kinley is going back toward the well. The crowd holds its breath. It is like watching a deep-sea diver going up to a volcano. This time he is carrying with him an asbestos-covered shell containing

just fifteen quarts of his high explosive.

He works quickly. The shell is suspended near the well, below the base of the blaze. He hurries away.

"Get back—everybody!"

At a safe distance, he grasps an electric switch. The plunger goes down. There is a violent blast. The column of oil is split in two as with a knife. High in the air, the jolted flames linger for a moment, but before they are reached by the new stream, spouting up from the well, they are dead, like a candle puffed out by a gust.

OTHER fire fighters, using explosives, frequently employ a method which does not require a personal approach to the flames.

A well was ablaze in Louisiana. The men engaged to extinguish it erected an upright post some distance away. From this meeting, they laid a cable in a sort of elongated half circle around the well, keeping away from the worst of the heat. The blaze was in a direct line between the two ends of the cable. They attached a nitroglycerine shell in the middle. Then they pulled the cable taut, and the shell swung into place over the well. Simultaneously, it was detonated by electricity.

Kinley has sometimes used similar devices, drawing the charges into position by wires. Wherever possible, however, he prefers to carry them by hand. It is more accurate, he thinks, and lessens the chance of a slip during the mechanical maneuvering.

"Suppose, for instance, your wires burn? Suppose the shell finds, or goes off in the wrong place?"

Occasionally, he relates, the first explosion fails to extinguish the blaze, and it is necessary to try again with a heavier charge. But judgment, gained by experience, has greatly minimized these instances.

KINLEY describes his approach to a well:

"I go up with the wind at my back. One of the greatest menaces is the sudden gust from the opposite direction, which whips the flames around you. Sometimes I have them play a stream of water on me while I'm working in close to the fire. But it gets burning hot in spite of all you can do, and the asbestos suit seems to weigh a ton. I work without it whenever I can. I can move faster that way."

"A gas fire isn't so bad as an oil fire. Gas burns quite a distance above the ground, after it mixes with the right quantity of air. You can get in under it, in a way. There is usually a strong draft rushing in and rising to the blaze. That keeps you comparatively cooler than at an oil fire."

"Comparatively cool," however, does not mean shivering. There was, for example, his experience in extinguishing the flames at an oil well near Wewoka, Oklahoma.

"I was in close, hanging up a shell," he relates. "It began to get too hot around there. I couldn't drop the shell or leave it in the wrong position, so I had to stick till it was fixed." But before he could finish and get away, the intense heat had put big blisters on his hands and face.

Placing the explosive is not the only close-up work necessary in fighting these blazes. Kinley describes another problem that must be met.

"Burning embers and red-hot pieces of machinery lie all around the well. They have to be cooled off or gotten out of the way, or they'll start a new fire. I remember one gas well blaze that was extinguished. The gas was still coming out of the well with a roar. The valves had been put out of commission by the fire. All of a sudden there was a flash, a new kind of roar, and flame shot up from the well. It had been ignited by some smoldering débris, and the whole job had to be done over again."

"**I**'VE seen wells catch three or four times before they finally got them out for good."

Before extinguishing the main blaze, therefore, great care is taken to eliminate this menace. Sometimes the smoldering ground fires are smothered with steam, sent in hissing streams sixty or eighty feet from the nozzles of pipes hooked up to boilers.

As he recalls it, the process was developed by accident.

"A big well was on fire in the Taft field in California, in 1914. Nobody had been able to put it out. They decided to try to cave in the ground around the hole and choke it up, so as to stop the flow. My father, I, and a couple of other men were on the job."

WE PLANTED a charge of explosives pretty near the well, then cleared back out of the way. We set it off, and the dirt flew. The well went right on roaring. The flow wasn't even slackened. But the fire was out!

"Just that instant of explosion was enough to separate the blaze from its fuel. Accidentally, we had discovered a brand-new way to blow out oil fires."

At the present time perhaps a half dozen men are using the blasting method regularly, besides various other methods for special cases. Those who are recognized as experienced are frequently called to jobs from great distances, Kinley having received hurry calls several times to fly by plane to extinguish blazes in South America.

Time is a vital consideration to the oil well fire fighter, because of the value of the oil or gas consumed; which is why Kinley frequently takes the air route to a fire. One day sooner for the extinguishing, he explains, may mean a saving of thousands of dollars.

OIL fires start in some queer ways," he says. "Lightning, of course, is the cause of a great many. A derrick makes a good target for a bolt. The country for miles around may not have anything else so tall."

"I've seen oil conflagrations that were caused by grass fires, too. They'd burn up close to the well, without being noticed perhaps, and then they'd touch a puddle of oil or some gas that was hanging close to the ground."

Many fires have started when wells were first "brought in." Oddly, this seldom happens when a well is "shot." In such a case the driller, expecting oil or gas, has taken the necessary precautions. All open flames are extinguished. If the boiler is near the well, the fire under it is put out.

"It's when they aren't looking for it that trouble pops," says Kinley. "Comparatively speaking, the wildcatter—the man who is drilling a well in some territory that has never been tested before—is in the worst danger. He doesn't know exactly what he's going to find until his tools dig into it. All of a sudden he opens a gas pocket. Before he knows it, there's an explosion."

Even in proven fields these pockets may occur at unexpected depths. A well was being put down near Henryetta, Oklahoma. It was still several hundred feet above the level at which oil had been found elsewhere in that field. The driller was standing on his stool, six feet above the derrick floor, adjusting a cable.

Quite unexpectedly, the line going

Next Month!

If you have ever felt the lure of adventure, you will want to read

"BARE HANDS"

A Fascinating Novel of the Far North by

HAWTHORNE DANIEL

which begins in our March issue, on your news stand

February 10

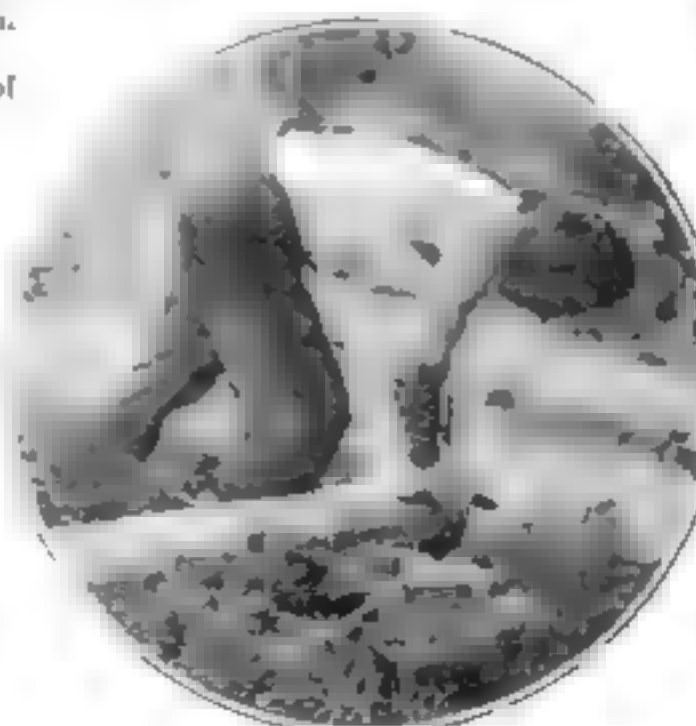
Sometimes water is used to cool the debris to the safety point.

But on other occasions chains or cables must be carried into the zone of heat and made fast to huge pieces of glowing, white-hot metal, which are then dragged away.

"One of the hardest jobs of this kind came in the Arkansas fields," says Kinley. "A gas well on fire there was blasted out, but then it caught again. The ground had been pretty thoroughly cleaned up, but the dualized control-head of the well was so hot it had ignited the gas. We got an iron cart and pushed it up to the fire with metal rods. It was maneuvered right over the control-head and fastened to it. We attached chains to the cart, hitched up teams of horses, and so tore the control-head from the well."

"After that I took another shell in. The blaze went out and stayed out."

Kinley claims the distinction of being one of the men on the job when discovery was first made of the value of high explosives in extinguishing this type of fire.



"Perfectly Safe!" Says Kinley

Kinley is an oil well shooter, too. Here he is loading a shell preparatory to planting a charge. The substance in the box is gelatinized nitroglycerin, which he cuts in cylindrical form in a cook cuts candies out of dough.

into the well grew slack. There was a rumble, and a stream of oil and gas shot out of the hole. Somehow, almost within an instant, it took fire. The driller, on top of the stool, jumped for his life. He managed to escape from the derrick without injury.

Even when the arrival of oil is strictly according to schedule there is an occasional fire.

"There was one case over in Arkansas," relates Kinley. "The driller was ready to bring the well in, and the boiler had been put out. There wasn't an open flame anywhere around. Sometimes a derrick is lighted by gas flares; they have to be put out, too. But this rig had electric lights."

THE well came in with a roar. There was a rush of oil and gas. It spouted to the top of the derrick. Probably there were some rocks in it, too; you often hear them clattering against the rig when a gusher comes in like that.

"Somehow, one of the electric light bulbs was broken. At least they figured afterward that that was what happened. After the bulb was broken, the filament must have stayed hot enough to set fire to the oil or gas. In a second the whole stream was burning."

For a really unusual happening the story of a certain northern Oklahoma well is worth repeating. Its truth is vouched for by a large torpedo company, with "shooters" working throughout the oil fields.

A charge of nitroglycerin was detonated in the well. Gas came bursting out, with a shower of rocks. Some of the rocks struck the metal crown block at the very top of the derrick. There were sparks. The gas caught. And just at that instant, the oil—mixed at first with the water that had been in the hole—shot upward and smothered the blaze!

THREE'S another kind of oil field fire, quite as spectacular as a blazing well. It is a burning storage tank. When one of these gigantic reservoirs catches, it presents problems not to be met by blasting. It is a little apart from Kinley's specialty, but he has taken part in fighting such conflagrations.

"The first thing is to get as much of the oil as possible out of the tank," he explains. "While the surface is burning, we pump it out from below as fast as we can, which usually isn't fast enough. We cut new outlets and throw up earth dams to hold the oil. Sometimes even a small cannon is used, to shoot holes into a tank and drain it."

"The flames on top of the oil in the tank

will burn a while, and then a crust will form, or gas will collect, and there'll be an explosion. It may throw blazing oil into some other tank which hasn't caught fire as yet."

"Sometimes we use chemicals to

leak in the bottom of a tank) become so hot that it boils upward. It mixes with the burning oil, and the tank foams over the top. In a moment it had ignited the oil already on the ground, and the whole place was a flaming lake."

When Kinley is not engaged in fire fighting, he is frequently "shooting" wells. That is, in fact, his original occupation. For this purpose, also, he employs gelatinized glycerin instead of the regular nitroglycerin used by the majority of shooters.

PLANTING a charge in a well west of Drumright, Oklahoma, he explained the reason for his preference in explosives:

"It may not give quite so quick an explosion, but it's safer!"

He was busy prying the lids from wooden boxes loaded in the back of his car. The drilling crew and the owner of the well, with two friends, watched the preparations for the shot. Each of the boxes contained a thirty-four-pound block of high explosive. It was a yellowish brown substance, rather elastic, and quite harmless in appearance.

Kinley took one of his empty tin shells and began to cut cylinders out of the solid block, in much the way that a cook cuts cookies from dough. He sipped the cut-out pieces into the shell, and wadded loose strips of the substance into the spaces left vacant. The spectators retired to a safer distance as he lifted the shell up and down, thumping it against the ground to pack the charge more solidly.

"Perfectly safe," said Kinley.

HE PUT a separate detonator into each shell which he lowered into the well.

"That's to make sure that they all go off at the same time when I drop the squat," he explained.

Apparently they all did go off. Before the shot only a gaseous vapor was rising from the well. A few moments later water and oil and rocks spouted over the top of the derrick, and the well settled down to a steady flow of oil.

Kinley has conducted startling demonstrations to prove the safety of his gelatinized glycerin.

"I took a box of it up in an airplane," he relates, "and dropped it into a field. Of course it didn't explode. Why some people are afraid of it I can't imagine."

He started his auto back on the road to Tulsa. Other motorists did not seem ahay of it.

"Why should they be?" Kinley demanded. "What's dangerous about it? I courted my wife in a car like this!"



Thousands of Dollars Go Up in Smoke

Picture fighting a blaze like this, single handed, in heat that melted a steel derrick! "I walk up to it with the wind at my back," says Kinley. "One of the greatest dangers is the sudden gust from the other side, that whips the flames and smoke about you. In such terrible heat I have them play a stream of water on me while I place the explosive at the base of the flame."

check these explosions, and sometimes we try to smother the fire with steam. The principal thing, though, is to get the oil out of the way."

One recent tank fire showed graphically the difficulties which arise. It contained 50,000 barrels of crude oil—more than 2,000,000 gallons, worth almost \$100,000. Within a few minutes after the fire started the sky was black with smoke. The blaze gave off a violent heat. Workmen built a dirt embankment, encircling the tank, and cut holes near the bottom. The oil began to pour out upon the ground into the reservoir prepared for it.

But the water (which frequently col-

Mysteries of The VIKING Trail *And Other Strange Tales of Lost Ships*

By H. C. NORTH

"Without a Trace!"

William W. Nutting and the sloop in which he and three companions left Norway in 1924 to follow the Viking trail to America. For nearly three years the fate of this vessel and its crew has been a mystery.

LOST at sea! Swallowed completely, without leaving sign or trace to suggest the story. Not one survivor, not a spar nor a boat. Not a word. Just the silence of the sea. And the fate of the ship and all aboard forever remains a mystery.

There is something fearsome, something awful, in the thought of a lost ship, which fills the imagination with terror. A weirdness attaches itself to these strange disappearances which cannot be cast off. You can tell the same that it is the fear of the unknown, and he will nod, but he will mutter among his mates that nothing is too strange, nothing too unusual to happen at sea.

The arrival from Norway of the Viking ship, *Lief Erickson*, which was sailed to this country and exhibited at the Sesquicentennial in Philadelphia in commemoration of the voyage of Lief the Lucky to America, again arouses interest in that other *Lief Erickson* and her valiant commander, William Nutting.

William W. Nutting, New York editor and sportsman, had contributed an adventurous and thrilling page to the history of yachting. But he had also studied the explorations of Lief Erickson on the North American continent, 500 years before the landing of Columbus. Thrilled by the spirit of adventure of those Viking sailors, he conceived the idea of sailing his small ship over the Viking trail—Norway, Iceland, Greenland, Labrador—

previously followed by the Viking discoverer after whom he named his boat.

With three companions, one of whom was J. O. Todahl, member of the art staff of POPULAR SCIENCE MONTHLY, he sailed from Bergen in July, 1924. His craft was a forty-two-foot auxiliary with a twelve-horsepower motor, of the type used by Norwegian fishermen in winter patrol work.

REACHING Iceland without mishap, Nutting made his departure for Greenland on August 10th. He had planned to touch on the east coast of Greenland, but reports of an unusual amount of ice there caused him to change his mind. He landed, instead, on the west coast, whence he sailed on September 9th for Labrador. With that date the story of the sturdy little ship and its daring crew ends.

Has the *Lief Erickson* met the fate of the *Erebus*, the *Jeannette*, the *Terror*, the *Fury*, and of the many other ships claimed by the frozen clutches of the Viking trail? Or is she locked in some icy port, unable to put out and complete her dangerous journey? More than two years have passed, and seafarers are still speculating. The U. S. Navy scout cruiser, *Trenton*, searched the northern waste for weeks. Radio messages were sent to all the Hudson's Bay Company's posts in Labrador and the vicinity in the hope that some word from the crew might

return. Later, in a last desperate effort, the *Dono*, a Danish scientific ship, cruised along the coast of Greenland in a hunt for the vanished boat. The voyage was fruitless, the white formidable stretches of the north kept their secret.

Seamen offer many explanations of what might have happened; nor do they think it impossible that some trace may still be found. That the *Lief* was swamped is unlikely, for she was designed to withstand any sea, and was manned by a most able crew. That the vessel was crushed by the ice floes is also held improbable; there was little ice in the course which she ultimately pursued. Fire is the most likely theory, in her hold the *Lief* carried hundreds of feet of film.

THIS true story will perhaps remain a mystery for all time. Yet within the year, or the week, the discovery of a frozen bulk, the finding of an abandoned camp may tell the tale. It is not without the realms of possibility that Nutting, himself, will return some day, with his fearless crew, to relate his exploits.

Even outside the frozen waters of the North the annals of the sea are filled with strange disappearances. The sea is full of strange pranks, as the sailor knows, and to prove it he points to the score and more of huge Atlantic liners which have utterly and completely vanished during the last fifty years.

The *President*, embarking from New York on March 11, 1841, was the first large steamer to leave port and sail into oblivion with never a word or a hint of her sufferings drifting back. Of the 130 persons aboard, not so much as a rumor has ever returned. Yet bottles bearing messages for agonized families must have been intrusted to the angry waters; boats and rafts surely were launched; somewhere there must have been washed up shreds of evidence which disclose the tale of misery. The ship was practically new



and was commanded by one of the ablest seamen of the day; unusual circumstances, harrowing to contemplate, must have conspired against her.

The sea is full of strange pranks—pranks which color her traditions with mystery and superstition. Should we be surprised, then, that exactly thirteen years should pass after the loss of the *President*, before there was another great calamity at sea—thirteen years with only one life forfeited in the wreck of an Atlantic liner? We can shrug over the ill omen of the thirteen, and lay it down to strange coincidence. But sailors' yarns gain more respect when we learn that the next great disaster—come the thirteenth year—was also that of a ship of which nothing has ever been heard since she put out to sea! Four hundred and eighty living beings disappeared from human sight, with the *City of Glasgow*, in that unlucky year, 1854.

ALTHOUGH the *City of Glasgow* is often cited to silence the realist and the scuffer, the tales surrounding it do not compare with those of the predestined ship *Friday*. *Friday* has always been considered a day of bad fortune by seamen. No old-time mariner ever would leave port on a Friday, and the day was shunned, too, in beginning any other event in shipping. Almost a century ago, however, a New England skipper resolved to demonstrate his disbelief in this age-old superstition of sailor men. For this Yankee captain to have ordered the lumber for his craft on a Friday was bad enough, but when the lumber arrived on a Friday and he laid the keel on a Friday, his friends shook their heads. The headstrong man persisted. The boat was completed on Friday. It was on the following Friday that the ship was driven ashore with her load of lumber.

Supposedly because it had never been among seafarers general that the vessel's history record a Friday he put out to sea. Grimly we are told by . . .

salts (and with a certain amount of genuine satisfaction), the *Friday* disappeared over the horizon and from this world forever. There is no doubt among Salem and New Bedford folk that she was shoved to the bottom by the hand of an outraged providence.

The loss of the steamship *Woratah*, in 1903, was not without uncanny forebodings. The ship left London, April 27th, on the second voyage of her brief existence; touched Australian ports, and reached Durban. Here Claude Sawyer, a passenger, after warning the passengers that the ship was doomed, left the boat in a highly nervous state of mind.

"In the early morning," he explained, "I had this strange dream. I saw a man, dressed in a very peculiar dress which I had never seen before, with a long sword in his right hand, which he seemed to be holding between us. In the other hand he had a rag covered with blood. I saw that three times in rapid succession the same morning."

AFTER the *Woratah* had sailed, leaving Durban, he dreamed that he saw her in a raging sea, the waves dashing over her. He awoke half delirious, with the picture of the ship disappearing beneath the waves still in his mind.

The next news which Sawyer had of the *Woratah* was that she was overdue at Cape Town.

Despite Sawyer's apparition, little anxiety was felt for the vessel. She was a large twin-screw liner, modern in every respect; she had been inspected and declared serviceable before departure. Ships like that simply never get lost—so they said.

Nevertheless, the last heard, seen, or

known of the *Woratah* was that she passed the *Cape Macdui* shortly after putting out from Durban. Every passenger, officer, and sailor; every boat, board, or stick on the vessel vanished as completely as if dissolved by the salt water. Nor have the experts yet been able to explain the disappearance, without one solitary trace, of a vessel so equipped and so conditioned.

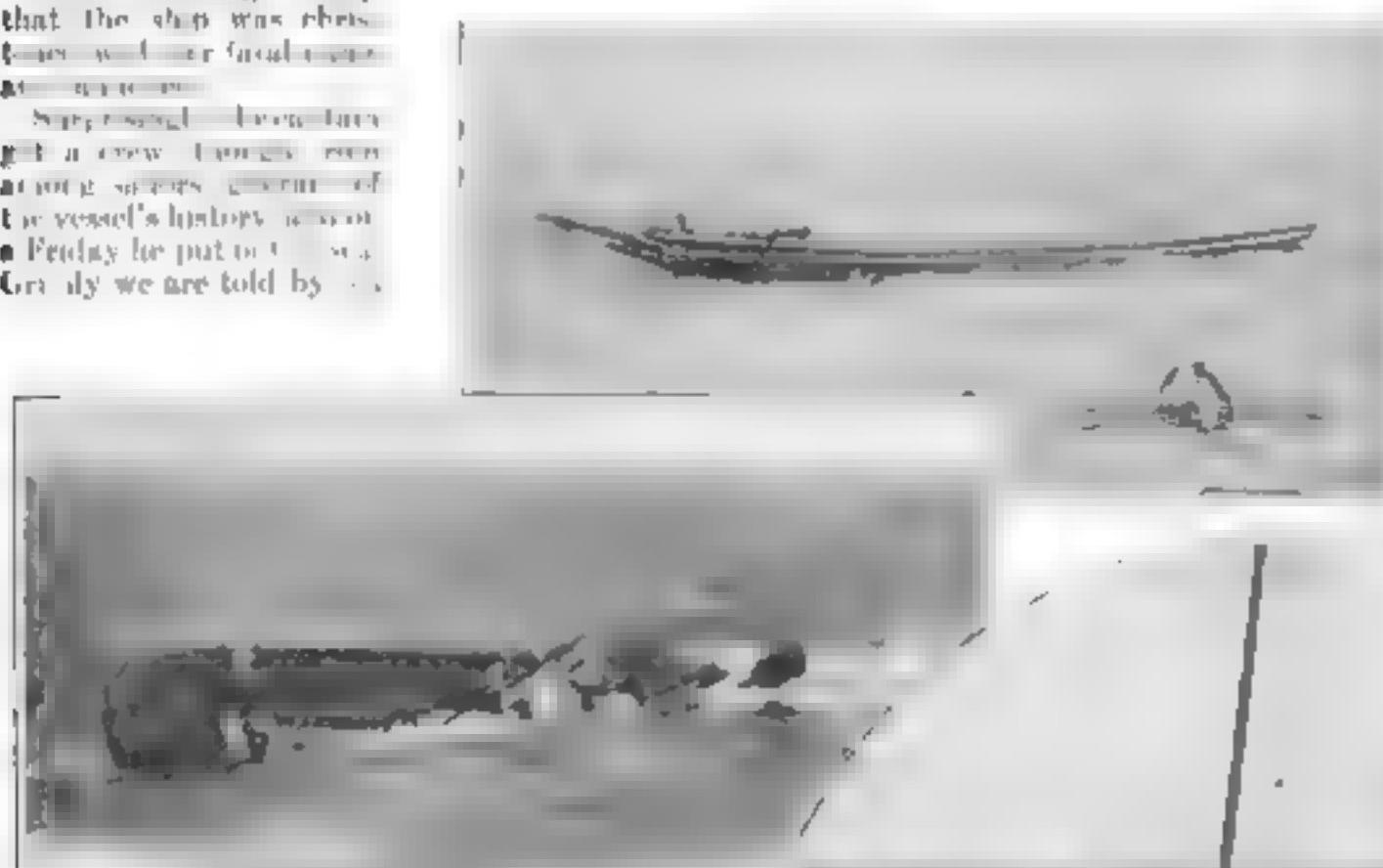
THIS it was with the *Pacific*, in 1850, and the *Tempest*, in 1859, and the *City of Boston*, in 1870; the *Condor*, in 1901, the *Huronian*, in 1902—and dozens of others. Of all those and of stranger mysteries, you will hear when sailors get together on stormy nights. Perhaps you will hear of the lost ships of La Pérouse, whose secret the sea gave up—nearly gave up—after the elapse of a half century, though the last adventure of La Pérouse can only be guessed at.

With all the color and dash of the French, the *Boussole* and the *Astrolobe* sailed from Brest under the command of that enterprising seaman, Jean François Galaup de la Pérouse. It was at the close of the eighteenth century, and the object of the voyage was to study and chart the Pacific. The personnel aboard the vessels, including many scientists of renown, numbered 223 men.

The instructions for the expedition, written by Louis XVI himself, were handed to La Pérouse on the gala occasion of the sailing. "The Sieur de la Pérouse" was to "invariably show the utmost kindness and humanity toward the different peoples visited in the course of his voyage. . . . His Majesty would consider it one of the happiest triumphs of the enterprise were it to be concluded without costing the life of a single man."

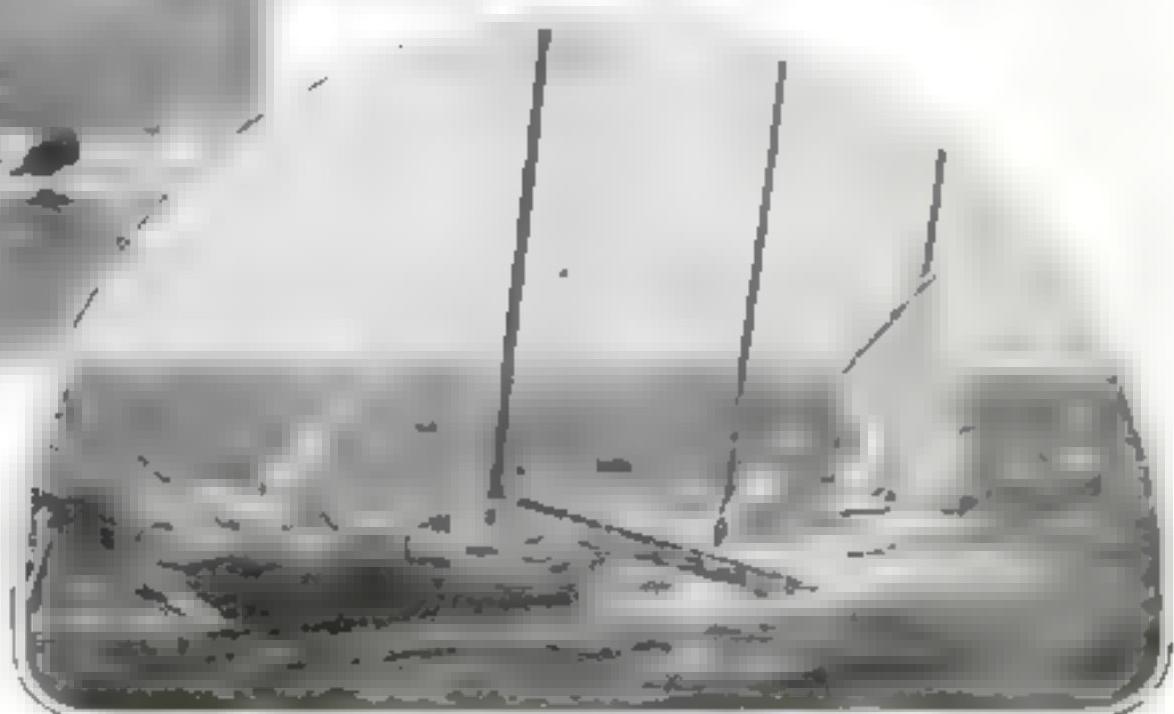
And so, with the most laudable purpose of any exploration of the unknown, general voyages and long oceanic trips of exploration, La Pérouse embarked on his . . .

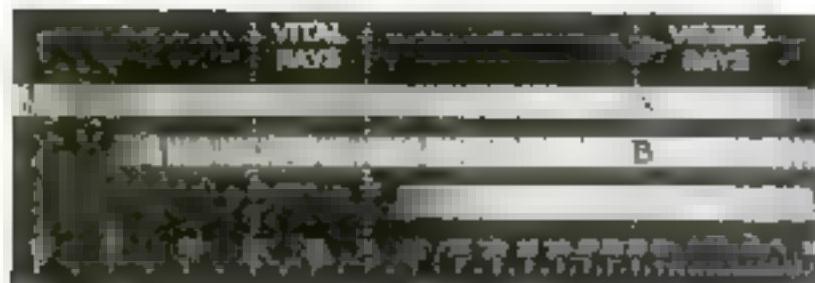
He rounded Cape Horn without a scratch, and spent two months navigating and charting the Pacific Coast. But soon the bad



Victims of the Sea's Cruel Pranks

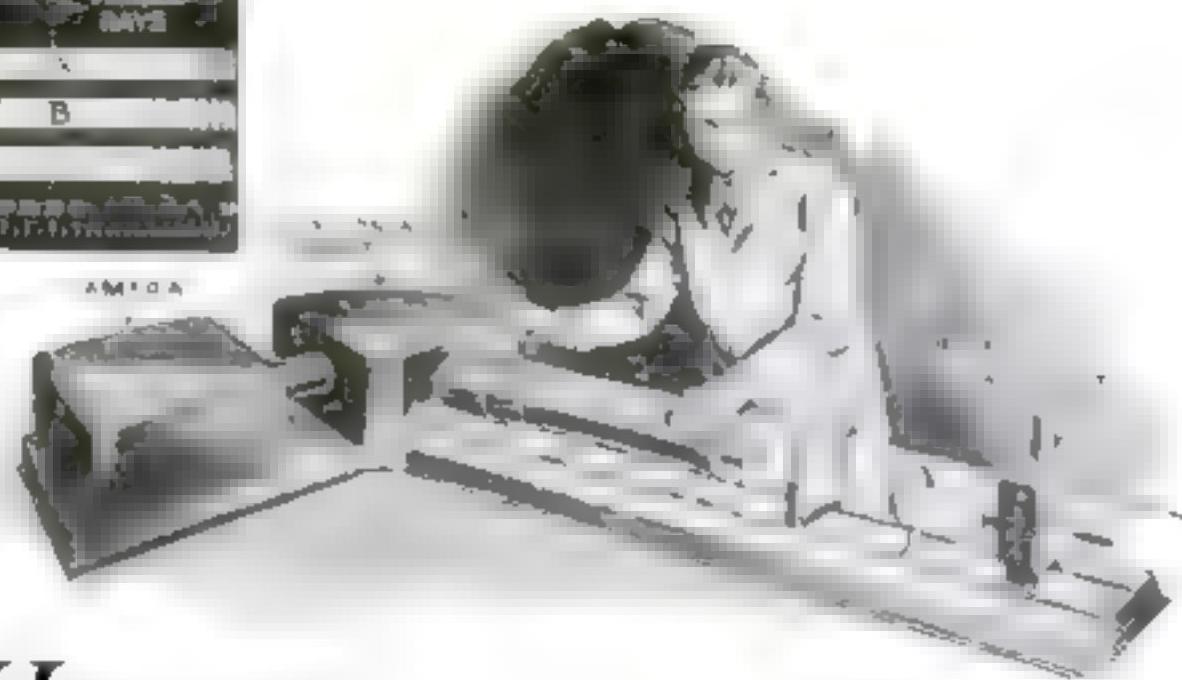
(Top) Coast guard going to blow up a derelict. Many of the ships that vanish mysteriously probably owe their fate to collision in the dark with such semi-submerged vessels. Above Even the progress of safe navigation has brought us into tragic sea disasters. Right An abandoned schooner found sinking recently in mid-ocean.





Camera Tests Glass

Spectrograph tests (right) give photographic proof (above) of the absorption by glass of light rays. The photo, scaled according to wave length of rays, shows A sun's rays unobstructed; B passes through new type of glass; (C through ordinary window glass).



Now We Have "Health Glass" for our Windows

*Novel Panes, Produced with Secret
Formulae, Admit Sun's Vital Rays*

WITH magic pipe cleaner has blown for us a bubble—a bubble that for promise and romance far surpasses any iridescent globule ever blown from childhood's pipe. It is made of glass, but a most wonderful glass, in appearance no different from ordinary window glass but in reality vastly different, because it will transmit more of the sunlight.

You probably think the glass in your window lets in the sunlight. It does, in a limited way. But it excludes the ultra-violet rays of the sun, the most important to life and growth of all the rays in the spectrum. These are the extremely short and invisible light waves, incidentally, that cause sunburn and tanning. You know you can stand behind an ordinary glass window and let the sun shine on you all summer without getting sunburned. That is because the glass cuts out the ultra-violet rays just as effectively as a brick wall does.

The new glass, however, will let the ultra-violet rays pass, and you would get no sunburned standing behind it as you walk on the beach. This new glass has a quartz base. Pure fused quartz glass is a perfect transmitter for ultra-violet rays, but pure quartz is too expensive for ordinary use. With quartz as the basis and certain other substances, which are kept secret, several glass manufacturers have now succeeded in making "sunlight" glass at about the cost of ordinary wire glass.

A British lighting engineer has developed one which he calls "vitaglass," and several American manufacturers are already in the field with similar prod-

ucts. One American concern is turning out a quartz glass capable of transmitting eighty-six percent of the shortest waves of sunlight through the thickness of an ordinary window pane.

Considering the fact that ordinary window glass keeps out wind and cold and lets in light, you might wonder why it is necessary to have a glass that will pass ultra-violet rays, especially if you have no particular desire to stand before a window to get sunburned. Any doctor will answer that question for you. Or the corner vegetable store man or the egg man might be able to answer it. For the ultra-violet rays of the sun affect the health and growth of everything in the animal and vegetable world.

THAT branch of medicine which has to do with the curative power of sunlight—heliotherapy—has grown rapidly in recent years. It is being employed to increase our resistance to infection, for the treatment of skin diseases, for the prevention and cure of rickets, and particularly in the treatment of tuberculosis of the bones, joints and glands.

By MANUS
McFADDEN

Heretofore curative sun treatments have been given mostly out-of-doors. Now with the new ultra-violet ray glass, it is possible to treat patients indoors.

THE curative possibilities of the discovery were surprisingly demonstrated recently in the London Zoo. The directors of the zoo, according to reports, were worried about a young orang-outang which was growing lird and ill-natured, a family of all-e Capuchin monkeys, and a number of aging iguanas lizards. One of the directors suggested substituting quartz glass for the ordinary window glass of the cages. When this was done, the orang-outang grew a new coat of healthy hair, and the other animals regained normal vitality.

Equally extraordinary were the results with greenhouse tests. Vegetables and flowers grown behind ultra-violet ray windows at the University of Wisconsin grew faster and more luxuriantly and it was found possible to grow plants that would not thrive in ordinary greenhouses. As ultimate results, the experimenters tell us, the most delicate fruits of the tropics

will be grown in the north, winter vegetables will easily be raised, extending the "green" season to all the year round, and the price of foodstuffs consequently will be decreased.

Installation of the glass in chicken houses has been followed by increased egg production. Used in schools instead of ordinary window glass, it is said to produce healthier school children. Still another use is in the production of unusual color filters.



Common Window Glass Blocks Health-Giving Rays

Diagram showing the absorption by ordinary glass of the sun's ultra-violet (vital) rays, as well as infra-red (heat) rays, as compared with the new glass.

BITS OF MECHANISM THAT SAVE US MILLIONS

Scales—Miracle Workers of Industry—Measure Fabric, Test Auto Parts, Even Count Trolley Car Tickets!

By
BOYDEN SPARKES

SHOPPOSE some mischievous scientist, an enemy of society, hit upon a principle that enabled him to interfere with the force that operates the myriads of scales—the weighing machines—that are a vital part of the mechanism of our modern world. The ruin of a large part of our civilization would follow.

Without the guidance of scales our manufacturing methods of mass production would have to give way to stone age methods. Business men would be as helpless in determining values as any half-witted reservation Indian enriched by oil, all our slowly won knowledge of medicine would be almost worthless because no druggist would dare sell any of the potent drugs, an extra pinch of which would bring death.

In short, if this calamity should occur, the people of America and other advanced nations of the earth would slip back rapidly into a primitive state for want of all the things that make our civilization possible. Happily, however, this disaster is not likely to occur so long as water flows down.

SCALES, all of them, are operated by the mysterious force we call gravity, that same force which keeps us, our houses, our dogs, our automobiles and other possessions from floating out into space as independent bits of cosmic jetsam.

One of the first things from which we would suffer if our world were suddenly deprived of the means of measuring bulk by employing gravity, would be a sudden and dizzy rise of prices for everything that goes on our table. That fact was demonstrated to me recently when I watched a salesman for a big scale com-



Aids in Road Building

Measuring the solidity of soil in Illinois over which it is contemplated to run a road. The work is done by means of a dial which tells instantly how deep and how quickly an iron rod sinks into the earth under a bucket load of shot. Soft spots are thus easily detected.

pany sell a butcher of our neighborhood a computing scale.

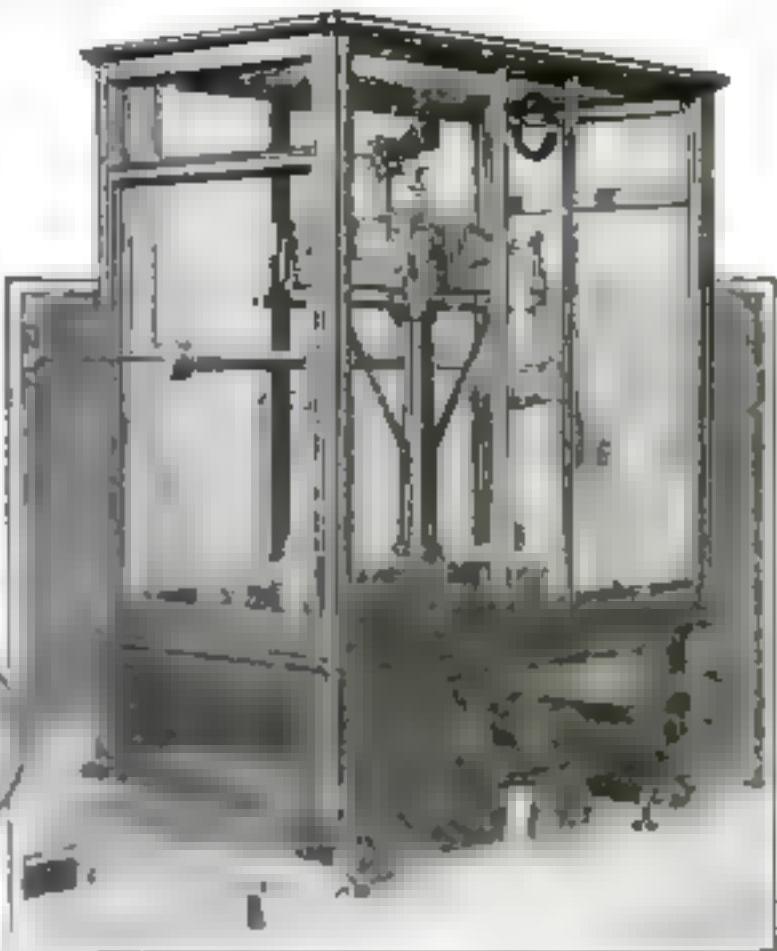
My butcher's name is Bloom, and he was partly "sold" on the idea of the new scales when I entered the store, because the salesman already had a white mechanism of porcelain on the counter beside Bloom's old scale, an old-fashioned device that jiggles up and down for some time after a slab of meat is dropped on it.

"Two pounds of porterhouse," I said when Bloom looked in my direction. "How much is it?"

"Fifty-three cents a pound." Old Bloom, whose cheeks are a network of tiny red veins and whose eyes are in little openings placed squarely beside his nose, began to sharpen his knife.

"I'd like to make you a proposition," suggested the salesman to the butcher, "I dare you to try to cut this customer's meat without weighing it."

"I can do it," boasted Bloom. "Think I don't know two pounds of meat?" he added truculently, but I noticed that even the suggestion was enough to make him survey a steak slightly thinner than



Weights to a Hundred-Millionth

Mr. Sparkes tells on these pages how gravity is being made to work for us in unreamed ways of scales so incredibly delicate that they can weigh the postmark on a postage stamp. The balance above at the U. S. Bureau of Standards compares two two-pound weights with an accuracy to a hundred-millionth.

the one he had intended to cut for me.

"Sure you can," agreed the salesman, "but let us see how long it takes to weigh it on your old scale. I know your scale is right, because we've just tested it, but I'd like to bet that my computing scale will tell to the cent the worth of that piece of meat much more quickly than you can figure it out of your head when you use your old pound-and-ounce scale."

"We'll try it," agreed Bloom, and cut into the meat. When his saw had sung its way through the bone, he dropped the meat on his old scale, and as he did so the scale salesman glanced at his wrist watch. Presently Bloom announced,

"One dollar, seventeen."

"Twenty seconds," said the salesman. I saw that the meat weighed two pounds and three ounces.

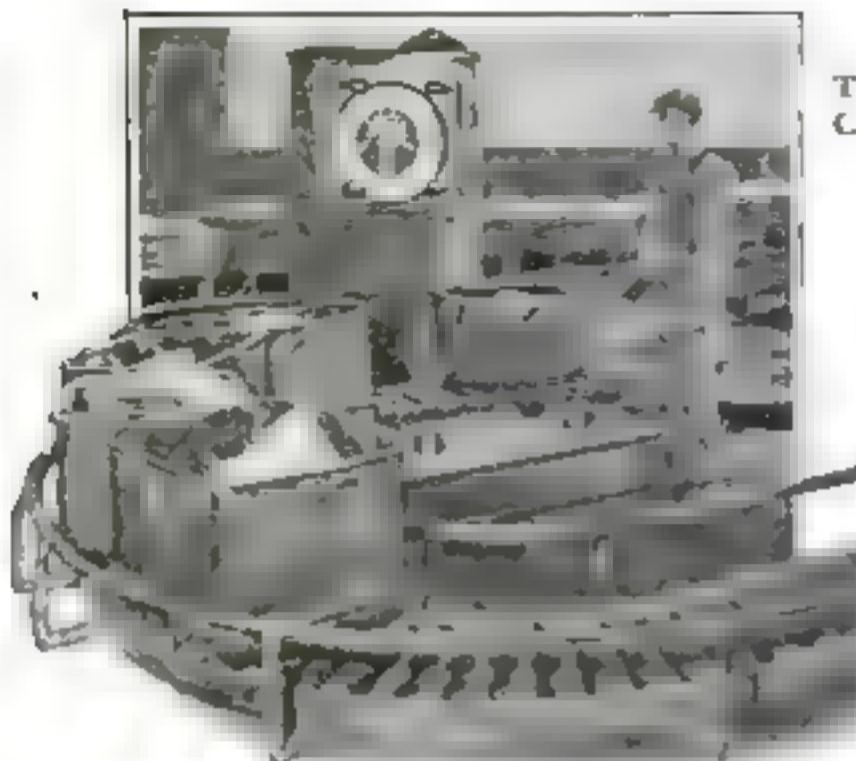
"Now watch my scale," said the salesman. With that he transferred the meat. As he did so, an electrically illuminated chart behind the magnifying glass on the face of the reading cylinder began to turn, not with a bounding motion, but with a slow movement. The instant it paused, the scale salesman announced the price of the meat.

"One dollar, nineteen."

"Well," acknowledged Bloom, "I was nearly right, and I didn't cheat the customer."

"I know that," agreed the salesman, "but whether you unintentionally cheat the customer or yourself, you lose. Either you lose profit or you lose a customer. In this case you were off two cents, to say nothing of the time you wasted. I'll bet, also, that you figured a little more carefully than you do when your store is crowded with customers."

"It is practically impossible," continued



A "guardian scale" in an auto tire factory checking the ingredients for rubber mixtures. It detects instantly if a basket contains too much or too little of each ingredient.

the salesman, "for a merchant to figure pounds and ounces accurately into money value without recourse to pencil and paper. It is even harder to calculate the price when fractions are involved.

NOW see how simple this calculating is done by the chart on this scale. It tells the exact price of anything weighing up to thirty pounds, within a cost range of from eight cents to seventy-five cents a pound. All the merchant and his customer do is read the figure indicated by the red line in the column of the chart reserved, as in this example, for goods worth fifty-three cents a pound. If it had been twelve cents a pound, you would have looked in the twelve-cent column."

"I guess you're right," said Bloom as he wrapped up my meat. "By the way, how much of a trade-in allowance will you give me for that old scale?"

They were dickering on that when I left. The next time I went after meat, the new scale was installed.

"It's paying for itself!" boasted Bloom. "It's saving time and wear and tear on my brain. You can kick about the high price of meat all you want to, but if I didn't have any scale at all I'd have to work with a tape measure, and then you'd have something to hover about."

THE fact of the matter is, a majority of us are able to live away from farms largely because of the important work done by scales as task masters, permitting that fine division of labor that marks the chief difference between civilized folks and savages. But scales are more than task masters and price fixers in our present scheme of existence. They are tremendous labor savers.

A few months ago I was guided through the

mechanical departments of a big magazine publishing house, the largest in the world, having facilities for the production of 800,000 magazines a day. Hundreds of girls were at work in the bindery of that mass of machinery that I had previously thought of only as a place dominated by an editor. The printed sections of the magazines were traveling past these girls, whose busy skillful fingers were steadily bringing them toward completion. Suddenly I noticed that three books in succession were rejected by the traveling mechanism so that they dropped out of the moving line.

WHAT happened?" I asked my guide, a young woman.

"Just a couple of light ones," she explained. "Someone failed to put in all the sections a completed copy should have."

"I can understand that," I interrupted, "But—"

"The missing section undoubtedly contained parts of a couple of stories and some advertising, and the subscribers who received them would have frothed at the mouth."

"But," I insisted, "what influence or what inspector found out about those defective copies? Why were the copies

thrown out in that mysterious fashion?"

"Oh," said my guide, "that was done by a scale. There is a sensitive section in that monorail traveler, a weighing machine, and whenever a book comes along that weighs too little or too much, the scale rises or lowers. Gear wheels become engaged and bounce the defective copies out of the moving line."

Later I asked the mechanical superintendent what changes he would have to make if he could not use scales in his bindery. He replied:

"We would have to provide inspectors to turn the pages of every copy to be sure that each of our millions of magazines was complete. In that case we'd have to charge a lot more for the magazines."

WITHIN the last twenty years a hundred kinds of scales have been devised to release hundreds of thousands of human hands to other tasks, speeding production and reducing costs. If it is true, as scientists assert, that the ordinary man of today has at his beck and call the power of two slaves and countless horses, scales must be given a considerable part of the credit. The fact is, the gage with which the pressure of steam in boilers is weighed is a scale. The steam is permitted to shove, as a man might press with his shoulder, against a spring. If the steam presses so hard that danger threatens, a dial gives the warning. In other words, that steam pressure has been weighed just as the force of gravity is the thing we really weigh each time we interpose a scale between an object and the earth.

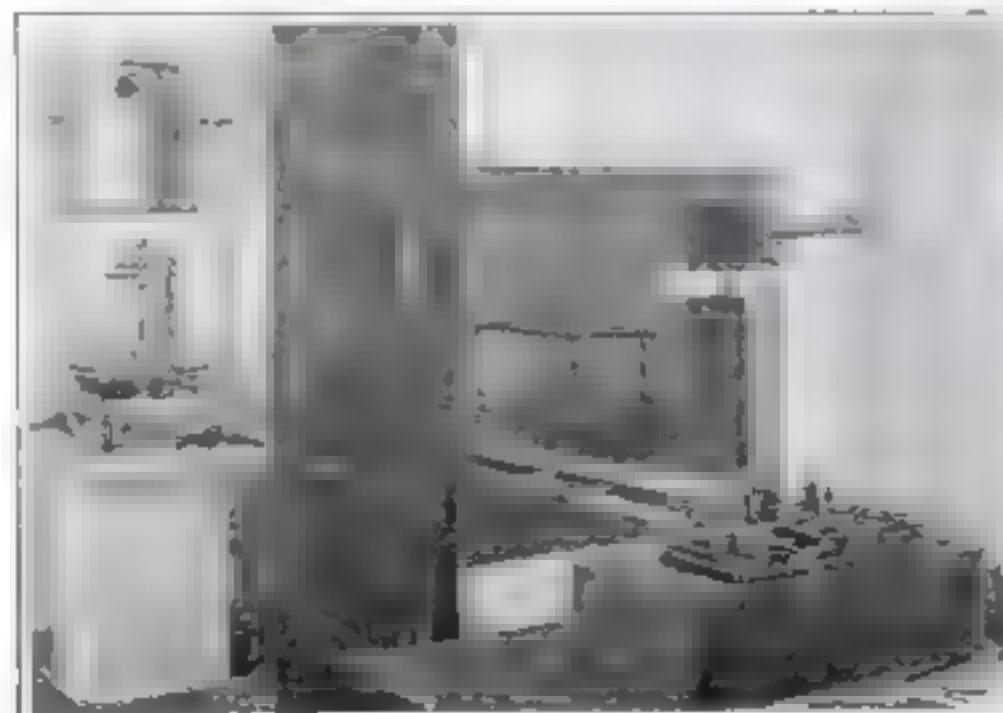
The uses to which scales are being applied are multiplying every day, and the men who are making the most profitable use of them believe that we have just begun to scratch the surface of the possibilities of employing gravity by this means.

Sometimes results almost weird are achieved by these
(Continued on page 155)



Two Reasons Why Cars Are Losing Tires

Testing automobile valve stems in a Detroit factory to show how they are made. Below, the scale used in the Bureau of Standards to know the stem is being measured.



A Marvel of Mechanistic Adjustment

Balance at the Bureau of Standards, so sensitive that it must be controlled from the next room, because the heat of the operator's body would alter its readings.

"President, Statesman—but Scientific Man First"



Thomas Jefferson—SCIENTIST

By

FRANK PARKER STOCKBRIDGE

He Gave Us Swivel Chairs, A Sod-Turning Plow, Even the Idea for Folding Auto Tops

EVERY time you fold down the top of your roadster to give yourself the full benefit of the rushing air, you can thank Thomas Jefferson for the invention which makes it possible for you to do so.

Every farmer who plows up an old meadow, turning the sod over upon itself, owes a debt of gratitude to Thomas Jefferson, inventor of the plow mold-board which makes modern grassland plowing possible.

Every desk worker tilting back in his comfortable swivel chair, or swinging easily around instead of having to get up and turn his chair, is under obligation to Thomas Jefferson, who invented that only improvement in seating devices since the time of the Pharaohs.

Every inventor who establishes in court his right to his invention against infringers can thank Thomas Jefferson for laying down the principle on which the United States Patent Office is founded, that the protection of the inventor is of more consequence than possible benefit to the State through the disclosure of his invention.

Any schoolboy knows of Thomas Jefferson, patriot, statesman, author of the Declaration of Independence, third President of the United States. Few have heard of Thomas Jefferson, naturalist, inventor, experimenter in every branch of the mechanical arts, patron of scientific research and father of the United States Patent Office. But the two Thomas Jeffersons are the same individual, the red-headed Virginian who took with him from the College of William and Mary, where he was graduated in 1763 at the age of twenty, "a familiarity with the higher mathematics and natural sciences only possessed, at his age, by men who have a rare natural taste and ability for those studies," as one biographer puts it.

Even a partial catalogue of his achievements and activities in science and invention would occupy pages. His name is preserved in the annals of science in the Latinized technical name of an extinct ground sloth whose fossilized remains he was the first to describe, *Megalonyx Jeffersoni*. He introduced numerous European fruits and vegetables into the New World, and found new markets and uses in Europe for the products of America. When he was President, he laid the foundation for the modern system of Government crop reporting by personally watching the markets of Washington for eight years and recording the earliest and latest appearance of thirty-seven different farm products.

While taking one of the most active parts in the politics of the nation for more than forty years, he found time to carry on a voluminous correspondence with the foremost men of science in America to devise numerous devices still in use, the need of which, like the folding leather buggy top and the sod-turning plow, were suggested by operations on his own farm; to design and build structures which still stand as among the most

THOMAS JEFFERSON, third president of the United States, drew the plans for the University of Virginia, regarded today as one of the most beautiful groups of buildings in America. His introduction of the Classic Renaissance style of architecture into America was one of his many contributions outside the field of statescraft.

perfect examples of Classic Renaissance architecture; and in a hundred ways to promote the study of America's natural resources and encourage American inventiveness.

Only Franklin, among all Americans, did so many things and did them all so well.

"For a scientific man in town," he wrote, "nothing can furnish so convenient an amusement as chemistry, because it can be pursued in his cabinet, but for a country gentleman I know no source of amusement and health equal to botany and natural history." He thought of himself, not as a statesman first but as a "scientific man," as Theodore Roosevelt, a hundred years later, was to leave the White House to return to his first love, the study of wild animals, and to describe himself as a "faunal naturalist."

DATES are lacking for most of Jefferson's mechanical inventions, for he never applied for a patent, "never having thought of monopolizing by patent any useful idea which happens to offer itself to me," as he wrote to a friend in describing a hemp beater he had invented. All through his correspondence appear references to things which he had made, often accompanied by descriptions to enable others to make them. There was, perhaps, a little touch of the aristocratic tradition in his refusal to benefit pecuniarily by the products of his own skill.

As Secretary of State in Washington's first cabinet it fell to Jefferson to organize the Patent Office for which the Constitution had provided. All earlier ideas of patents, in England and on the Continent, had been based on the idea of the benefit to the State of inducing the inventor to patent—literally "make public"—the secret of his invention. American patent laws,

(Continued on page 142)

A New Feature

BEGINNING with the next issue, *Popular Science Monthly* will be expanded to include, in addition to its fact articles portraying the drama of progress, fiction stories based on achievement in the fields of science.

The innovation is undertaken in the belief that many of our modern miseries can be most interestingly portrayed in fiction form.

Don't miss the big March issue, on your news stand February 10th.

How Many Colors Can You See?



Analyzing the Color of a Wall

Looking through this spectrograph or color analyzer, the observer can determine the exact intensity of each of the colors reflected by the paint on the mottled wall at the right.

IN A certain New England factory production was too low in one department and employees were inefficient and dissatisfied. No one, least of all the manager, could discover what was wrong. Finally, a few months ago, the trouble was discovered. It was a wrong color of the working light.

Employees of this factory had the duty of inserting small yellowish parts into a larger device, also somewhat yellowish in color. The working light, ample in quantity, was also of yellowish tint, as nearly all artificial lights. Under it the larger device and the small parts looked much alike. A lighting engineer installed bright blue lights. These made the device and the parts, ready of slightly different shades of yellow, look gray and brown respectively. They were easy to see and easy to fit together. All trouble disappeared.

A similar instance occurred in Saint Luke's Hospital, in San Francisco. The surgeon in charge of the operating room discovered that it was easier to work in a room with green-colored walls than in the usual white-walled operating room. The reflected greenish light from the green walls made pink or reddish objects look darker and more distinct than in a clear white light. Small marks on the skin or other slight differences in the bodily tissues could be seen more easily by the surgeon, with corresponding advantages to his work.

THREE two examples are significant of the way in which color is now being studied by lighting experts and scientists, not primarily with the idea of making it ornamental, but in order to make it useful. The finding of jobs for scarlet and green and blue and all the rest of the color partners promises to be of great value to industry. It is not unreasonable to expect that within a few years each workbench of a factory and each counter of a salesroom will be painted its own proper color and illuminated with its own particular bank of lamps, both paint and lamp-color being designed to suit just the kind of work that is to go on at that spot.

There Are at Least a Million Tints — Scientists Are Giving Them New Jobs to Serve You

By
L. G. POPE

How the Colors Affect You

RED—Excites your emotions
ORANGE—Gives you high spirits
YELLOW—Stimulates your body
GREEN—Normal or neutral
BLUE—Depresses you physically
VIOLET—Makes you sad
PURPLE—Subdues



He Paints with Colored Lights

This ingenious experimental device shows how colored lights may be mixed, as an artist mixes his pigments, to produce desired effects. In this case three rays of different primary colors are being blended.

Dr. Ridgway's tested tints, thus making up the enormous number which can be seen.

This is for normal eyes. There exist, as everyone knows, people who are partially or completely color blind. These are the persons who mistake greens for reds and reds for grays or make even more ridiculous blunders. All of us, indeed, are likely to be just a little color blind. The number of people who wear glasses nowadays has driven home to everybody the fact that a great many human eyes are imperfect so far as seeing objects is concerned. Probably quite as large a percentage of our eyes would be found imperfect in seeing color.

ONE of my friends was much amused recently to find me examining samples of colored materials with my right eye only, the left eye being squinted shut. The explanation was that I knew, by former experiences, that my two eyes do not see colors with exactly the same perfection. For blues and yellows my right eye is better than my left eye. For reds and greens the difference evened up, for my left eye sees these colors more perfectly than does the right. The chances are that you will find a similar color difference in your own two eyes if you test them. Hold your two palms in front of your eyes and remove the hands alternately, looking meanwhile at some colored object, preferably something which is of a blue-green or a blue tint. You probably will notice that the object seems to change color slightly as you look at it first with one eye and then with the other.

The secrets of using colors to produce better vision lie in the contrast effects, the different absorption of objects for different colors and in the color principles, long known in color laboratories but little used outside these sequestered centers of research. The magnitude of the possibilities are indicated by the enormous number of distinct colors which the human eye can see.

Ask your friends how many distinct colors they can recognize. Most of them will guess that they can see fifty or a hundred separate colors. Very few will be willing to promise to distinguish between as many as a thousand different tints. In recent newspaper articles on color it was stated that the eye can see only some 1800 shades and hues.

All these estimates are ridiculously too low. Recent scientific tests have shown that even persons with eyes not trained to be especially color-sensitive can distinguish upwards of 60,000 separate colors, taking into account, of course, differences in light or dark shades as well as differences in hue. Artists can probably distinguish twice or three times as many colors as this. New gages recently developed by the U. S. Bureau of Standards are able to distinguish a million different possible color shades.

In the careful standard charts for color matching compiled by Dr. Robert Ridgway of the United States National Museum there are shown 1115 named colors, each of which has been analyzed for its exact physical composition. Any eye no matter how little trained, can see that many shades are possible between each two of

Recent studies of the blending of color in the human eye have great practical importance for all of us. William Andrew Mackay, New York artist and mural decorator, showed me not long ago in his studio two samples of gray wall. One gray seemed cold and dull; the other was warm and lifelike, as though it had bright sunlight on it, although no sun was shining. I walked nearer to the two walls. Suddenly the lively, sunlit gray seemed to change. It was no longer gray but a mosaic of colored spots—green, red and violet, all painted closely together.

MR. MACKAY explained that very small dots of color are not seen by the eye. They blend, inside the eye itself, into a single even color composed of something intermediate between the colors of the different spots. Far enough away from the "sunlit" wall I saw none of the tiny color specks. I merely saw the blended color. The other wall, which really was painted gray, I saw as a dull gray all the time. This idea, carried into the decoration of our homes, is giving us brighter and more cheerful surroundings.

These phenomena of color blending occur frequently in nature. Everyone knows, for example, that leaves are green, but very few know that leaves are also red. Yet analysis of the color of the leaf with a spectroscope shows that both green light and red light are reflected. The tint that we see is the result of the blending of these two colors inside our eyes. In the autumn, when the leaves "turn red," the green color of the leaves disappears, leaving the red alone to be seen.

In the same way, the blue color of the sky really contains all the colors of the

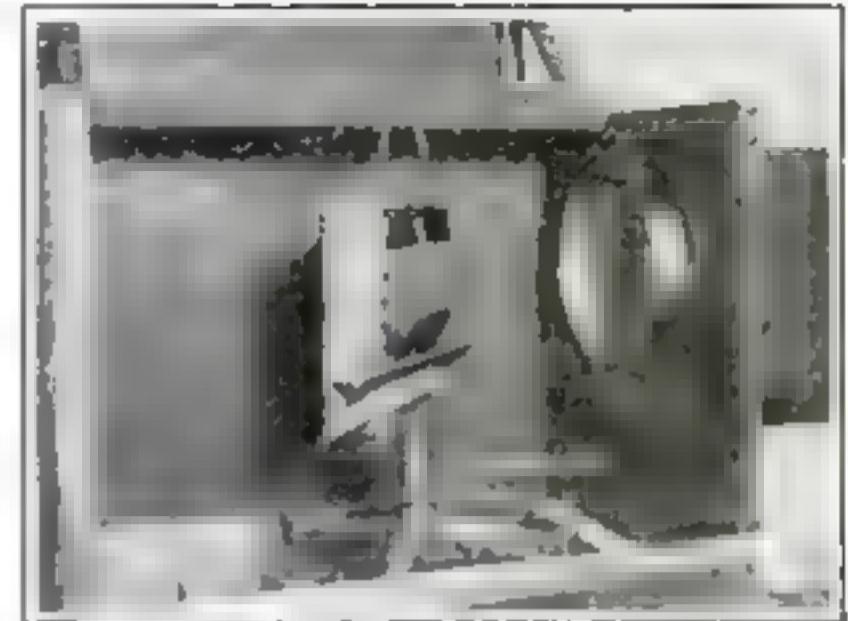
rainbow, as you can prove for yourself easily by looking at the sky through the glass prism of a spectroscope. The apparent blue is due, scientists now say, to a small excess amount of blue light reflected from the millions of dust particles in the air. That gives the tint to the daylight sky. On the tops of high mountains, where there is very little dust in the air to do this, the sky looks black, not blue.

The reddish and greenish tints that make the sky so beautiful at sunrise or sunset also are due to dust particles in the air. As the sun shines slantingly through the thickened atmosphere of the earth at that time of day, they alter the color of the sunlight to the pinks, reds and other colors seen. None of these colors are quite pure ones, nor are any colors in nature. All are mixed and blended. The greenish and bluish colors of sea water and of deep lakes, it has been found, are also due to light reflected from tiny suspended particles in the water. Water itself absorbs much of the red light, allowing green light to pass more readily. Accordingly, at depths of a few hundred feet under the sea, the light that filters down from the surface is yellowish green. This is why seaweeds that grow at these considerable depths are usually red or brown in color, not green. They are of colors which will absorb and retain the colors of light that get down to them, that is, the yellow and the green.

THE very complicated matter of the psychological effect of colors is causing large interest among the scientists, as well as among physicians and mental specialists. Recent dispatches from England describe an instance in which painting the walls of a workroom green instead of red calmed and soothed a group of workers previously found to be unduly excitable. The change in the workers was ascribed to the alteration of the wall color.

That different colors may have important effects on the mental state of people has been believed for many years. Some psychologists have gone so far as to prepare charts of the mental effects of different colors: red being stimulating and exciting, blue depressing, and so on. The best known of these charts, originally devised by the late Prof. Ogden N. Rood, of Columbia University, is summarized on the opposite page.

If we could trust completely such charts they would be of enormous service in deciding what colors to use for living rooms, for workrooms, for hospitals, and so on. But a careful German investigator, Dr. G. J. von Allesch, who



Splits Light into Its Many Hues

Prof. Albert A. Michelson of the University of Chicago, who recently redetermined the speed of light, devised this remarkable instrument for dividing light into its constituent colors. The plate at the center is ruled with an enormous number of very thin but accurate lines—about 15,000 lines to the inch. When a ray of mixed light falls on this grating through the lens at the right, the light is split into its many constituent colors.

recently completed a long series of tests, found that results varied widely between different individuals, and even for the same individual at different times.

On the other hand, in a long series of tests made on children in the schools of a western city several months ago, it was found that most of the children preferred red and orange colors to blue and violet ones. Red, for most people, is a cheerful, inspiring color. Probably that accounts for the optimists who wear red neckties.

A year or two ago a club for girls in Chicago conducted a course on how to make laggard young men propose. It was reported in the newspapers that the hopeful young ladies were urged to wear bright blue dresses when their suitors were to be "caught." I am no expert on proposals, but I venture the assertion that the advice was bad. Experts seem to agree that, on the average, pink or red is much more likely to stimulate emotion than "sober" colors such as blue, green or violet.

The purely physical side of the measurement and production of colors has been mastered much more completely than have the principles of color psychology. Photoelectric and colorimeters are available to determine, in unmistakable physical units, the percentages of each of the colors of the spectrum in any given paint or colored light. The physical interactions between colors are well known, so that it is entirely possible to paint a scene which will seem to change into something quite different when illuminated with another color of light. Emory Cobb Andrews, of Chicago, expert and experimenter on colors, is said to have in his laboratory a painting of an Indian maiden in a red gown. With a snap of the right switch the Indian maid becomes a negro, dressed in black.

SUCH changes are easy enough. They have even been accomplished in the theatre, changes of lights being used to produce apparent changes of scenery. These physical aspects of our relations to color have run far ahead of the psychological aspects. As in the case of the theory of how we see colors at all, here is a rich field for investigation.



Color Science Aids Gown Makers

How a color mixture disk is used to match and duplicate the color of a woman's gown. The disk is divided into fundamental colors. It is then whirled rapidly until the colors bleed. By changing the relative proportions of the colors on the disk it is possible to determine the exact mixture which will produce the desired tint. This serves as a guide in selecting dyes.

Huge Telescope to Solve Riddles

Amazing instrument may reveal secrets of Martian canals, the moon's craters, and find new universes off in space

CAN you conceive of a universe, other than ours, far beyond the range of the most powerful telescopes on earth today; so far away that its light must travel 500,000,000 years to reach us? And can you visualize a mammoth earthly "eye" so keen as to pierce the borderlands of space, capture the glimmer of unknown stars, and thus read the record of heavenly events as they transpired half a billion years ago?

Most of us who are not versed in astronomy find it difficult to encompass with our minds such distances of the starry skies. Still, there is present need for practice in imagination stretching, for the realization of so gigantic a vision is likely to come in the present generation.

Even as this is written, F. G. Pease, the man who planned the Hooker 100-inch reflector telescope, largest in the world, for the Mount Wilson Observatory in California, has completed designs for a new telescope three times as large. With a huge mirror twenty-five feet in diameter it will reveal objects nine times fainter than any heretofore disclosed, and details three times smaller. It will extend our knowledge immeasurably, and possibly quadruple the number of known stars in the heavens. The moving parts of the instrument alone would weigh 10,000 tons, and the cost of its construction would be in the neighborhood of \$12,000,000!

TO GET an idea of the power and possibilities of such a man-made "eye," imagine that the proposed telescope were set up on the moon and directed toward the earth. It would then enable a lunar observer to distinguish city blocks and the largest buildings in a metropolis like New York or Chicago! It would enable him to distinguish lights as close together as 100 feet. Transferred to the more distant planet Mars, it would make visible the distinct outlines of our metropolitan districts, our grain fields and forest areas. The earth's continents would be defined clearly, as on a relief map.

From the earth, such a telescope would solve for astronomers the riddle of the strange lines and markings on Mars. It would tell whether the so-called Martian canals are natural or artificial, and perhaps give a definite answer to the question whether our brother planet is inhabited. Similarly, it would show the faces of the other planets in finer detail than ever before.

But most fascinating of all would be the power of a tele-

scope of this size to peer beyond known limits of creation and discover new wonders of star-filled space. The 100-inch telescope on Mount Wilson, during the few years of its operation, already has given us an entirely new conception of the vastness of the universe. It has photographed spiral nebulae, and revealed these splotches of light to be separate universes or systems of stars much like our own Milky Way. The new telescope would bring to us images from distances three times greater! Whereas the present world's largest telescope may be able to photograph separate stars 3,000,000 light-years away, the proposed twenty-five-foot instrument should reveal individual stars at 8,000,000 or even 10,000,000 light-years. And as for nebulae or island universes, they should be made visible at distances of half a billion light-years! Are there any universes that far distant? Or will there be found a final borderline to creation?

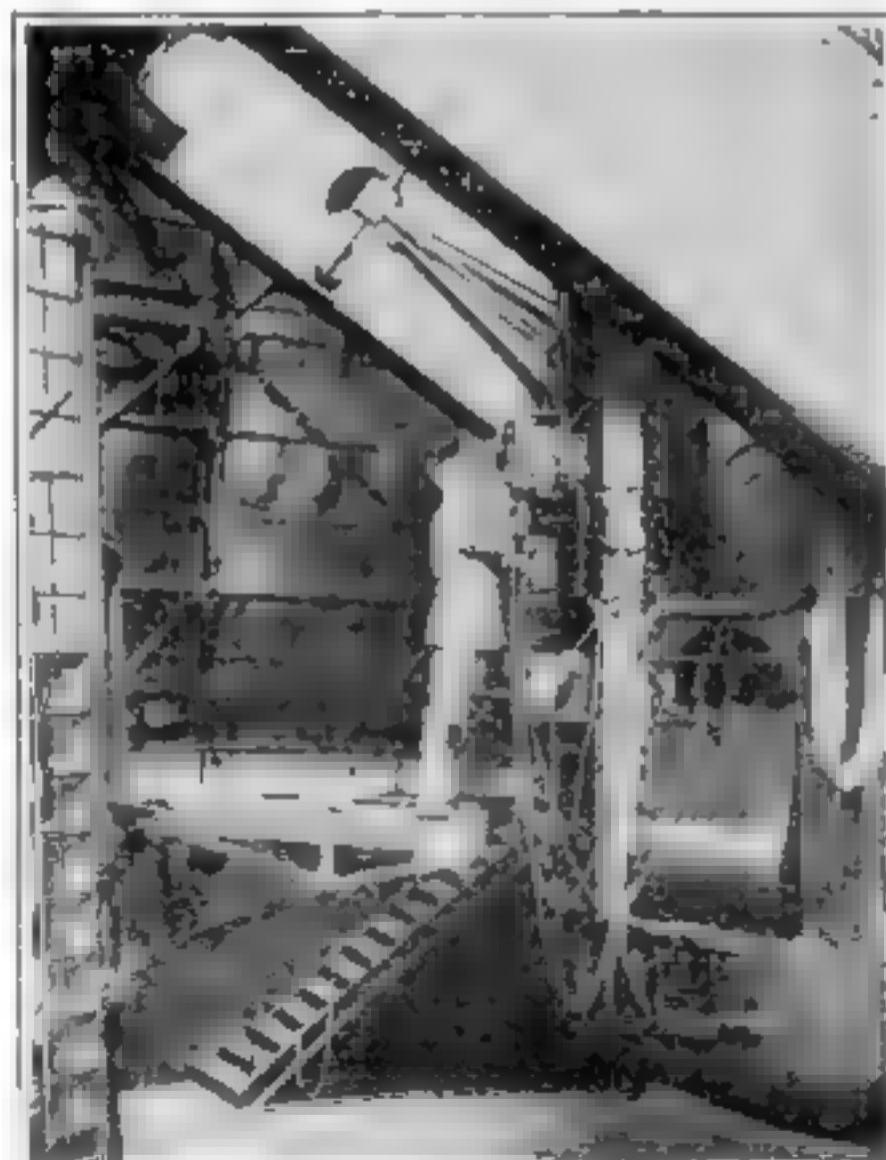
It is just here that most of us encounter the need for limbering our imaginations to comprehend the staggering distances revealed by the telescope. For a beginning exercise, the object whose distance probably can be grasped as readily as any is our sun, for its distance can be reckoned in familiar miles. The sun is only 92,000,-000 miles away. If we could motor there, traveling continuously at a speed of a mile a minute, the trip would take us 177 years. The light of the sun, which travels to us at the tremendous speed of 180,000 miles a second, takes just eight minutes to make the trip.

NEXT we turn to Neptune, the farthest planet of our solar system. Neptune is thirty times as far away as the sun. The motor trip to it would take a little more than five thousand years. Light from the planet takes four hours to travel to us.

Thus far, the distances are quite within the comprehension of a intelligent mortal accustomed to earthly measurements in miles, even though a mile now is dwarfed to comparative insignificance. But suppose we venture farther, beyond the limits of our solar system, to the nearest neighbor among the suns, the star Alpha Centauri. At once the need for a larger yardstick becomes apparent, for this nearest star is 300,000 times farther away from us than our sun. It is so far distant that its light must travel four years to reach us.

SO WE adopt a new and longer yardstick, the light-year, or the distance traveled by a ray of light in one year. You can figure for yourself this distance in miles. Light travels 180,000 miles a second, and there are 30,000,000 seconds in a year, in round numbers. Multiply these two together and you get the answer—more than five trillion miles. Write it down: 5,000,000,000,000 miles. That is one light-year.

Now, we are ready to journey out to the remote limits of our own universe or system of stars, the Milky Way. For a long time astronomers have known that the great, white, faintly luminous band you see across the sky at night, is really a conglomeration of

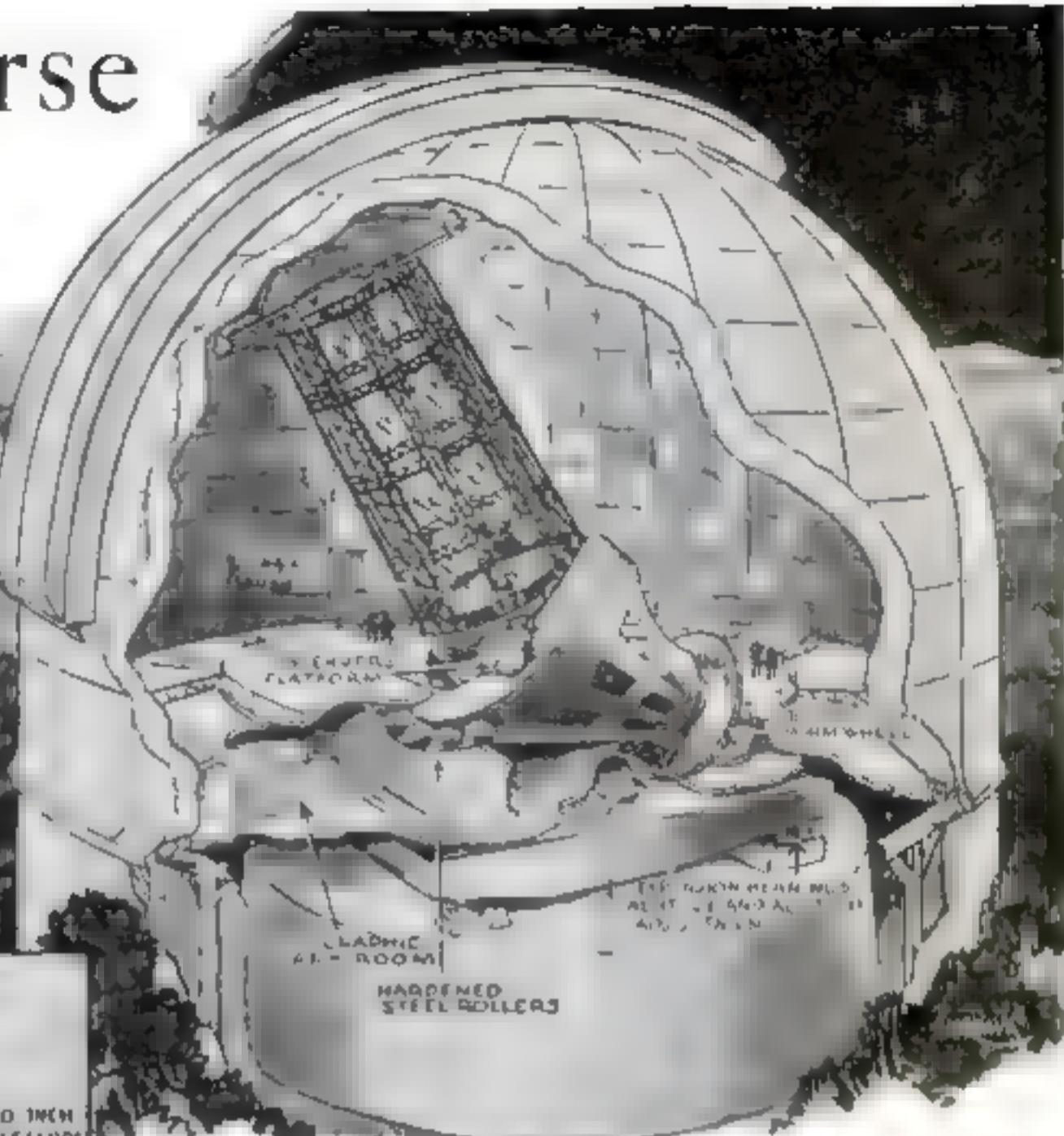
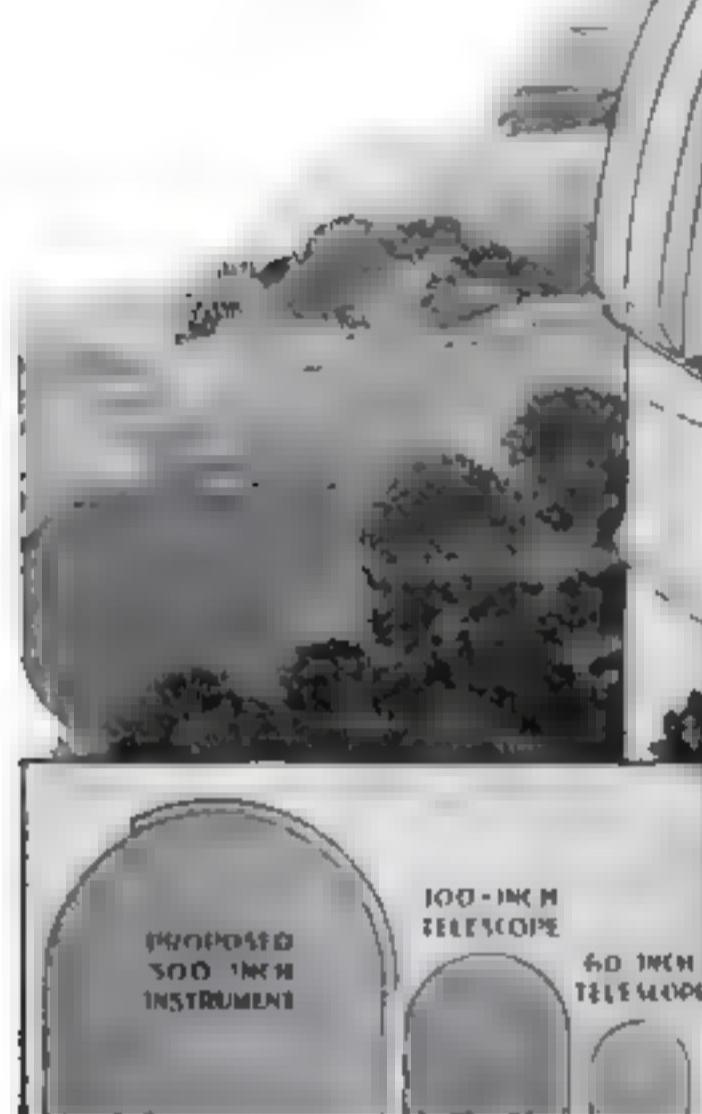


Sees 340,000,000,000,000,000 Miles!

F. G. Pease, designer of the proposed super-telescope, examining planets through the Mount Wilson telescope, at present the largest in the world and also designed by him. With this instrument stars eight hundred and forty million million miles away can be seen

of Universe

By
Robert E. Martin



The proposed 500-inch telescope as drawn by the artist at the plans prepared by Mr. Pease. Its tremendous size is seen by comparing with the 60-inch dome in the foreground. At a touch of a button, the telescope can turn in any angle desired. To be left a short time, it can stand upright.

millions of stars, so packed together that our eyes cannot distinguish them separately. The big telescopes, however, have resolved that cloudy band into individual stars, millions of them. By observing them carefully, astronomers have found that our Milky Way universe, or galaxy, is a disk-shaped organization of stars, with a diameter of about 300,000 light-years and a possible thickness of 37,500 light-years. Within its limits are approximately one billion stars, including our sun. Outside the system but still connected with it through the ties of universal attraction, are the so-called globular clusters, great conglomerations of stars, some of them hundreds of light-years in diameter.

All these objects together form our galactic system, or universe, which includes every class of star, nebula and star cluster we can observe, except one—the spiral nebulae. Astronomers tell us that these beautiful spiral shaped objects are far-distant separate universes like our own. Several thousands of them have been observed.

TO COMPREHEND the wonders of the spiral nebulae, we must stretch our imaginations one notch more. The best known of them all is the great nebula in Andromeda, the only one visible to the unaided eye. This universe is one million light-years away from us. It is one of the

largest of the spirals, 30,000 light-years in diameter. Within its borders many new stars have appeared from time to time. One of the brightest of these, which appeared in 1883, was just too faint to be seen with the naked eye, yet actually it was more than a hundred million times brighter than our sun! Such a star, it is believed, pours out into space energy and matter at the rate of more than two hundred trillion tons a second! It is so vast that while it is losing weight at this same terrific rate, the loss does not seem to affect it appreciably. In comparison, our sun is so insignificant that if it were placed the same distance away from us—a million light years—it would be entirely too faint to be seen with our largest telescopes.

IN the study of spiral nebulae much remains a vast mystery. No one yet, for example, has solved the puzzle of the twin universes, where two spiral nebulae are very close to one another and sometimes appear to be almost in contact. Here, in all likelihood, is a mighty collision of universes. Then there are several "nests" of universes, places in the sky where a great number of spiral nebulae are closely packed together in a small area. Are these, perhaps, the packing houses of creation, where universes are produced wholesale and brushed up before they are sent out on their journeys

through space? These are mysteries which the proposed mammoth telescope may eventually penetrate.

THREE construction of a monster reflector such as Mr. Pease has designed will call upon all the resourcefulness of astronomers, engineers and opticians. The making of a perfect disk mirror twenty-five feet in diameter, the heart of the instrument, will be an engineering achievement in itself. Not only must the mirror be made of materials that will remain clear and unmarred, but it must resist changes in temperature as well as possible changes in the curve of its surface when tilted at various angles. The surface itself must be ground to a curvature which is perfect to within a thousandth of an inch, otherwise distortion of images may result.

In spite of its tremendous size and weight, roller bearings and electric drive will make possible the movement of the instrument by the simple touch of a button. All the astronomer will need to do to observe a certain star will be to seat himself at a switchboard and press a certain button. Electricity will do the rest. Once the telescope is pointed at a star, it will remain pointed in that direction automatically. This will be accomplished by an electric clock which will keep the telescope moving just enough to counteract the rotation of the earth on its axis.

Ocean, Sun, Winds and Rocks Hold Vast Stores of Future Power

*Wonderful New Inventions Harness the Deep Sea
and Change Coal into Artificial Gasoline and Oil*

By HYATT E. GIBSON

SOME day—perhaps a hundred years from now, perhaps sooner—our children's children will read of the doings of the year 1927 and will wonder at the wastefulness of "those quaint people of the olden days who shoveled lumps of coal into furnaces to get heat and power, and who depended on wells dug into the ground to supply oil and gasoline for their motors."

For in that day people will have learned how to bridle the ceaseless energy of the sun, winds and waves, and to produce man-made fuels surpassing in efficiency and economy any of the raw fire-foods which the earth now supplies in ever diminishing quantities.

For evidence that such a day is coming we need only turn to the events of the last few months, and count the many amazing discoveries of new sources of fuel and power.

Only the other day, for example, a noted inventor, Prof. Georges Claude, demonstrated before the French Academy of Science that not merely the ocean waves, but the temperatures of sea water at various depths, hold immeasurable stores of usable power. He actually demonstrated a working model of a generator that draws power from the difference in temperature between the tepid water at the surface of tropic seas and the cold water at a depth of some 3,000 feet. In a partial vacuum, he showed, the tepid surface water will boil of its own volition. The resulting steam can be fed to a turbine, thence to a condenser which, with the aid of frigid water from the depths, increases the vacuum and consequently the efficiency of the transmitter. He declared that for every forty thousand cubic feet of water a second, there could be generated 400,000 kilowatts of power, or, i.e., to the combined power of more than half a million horses.

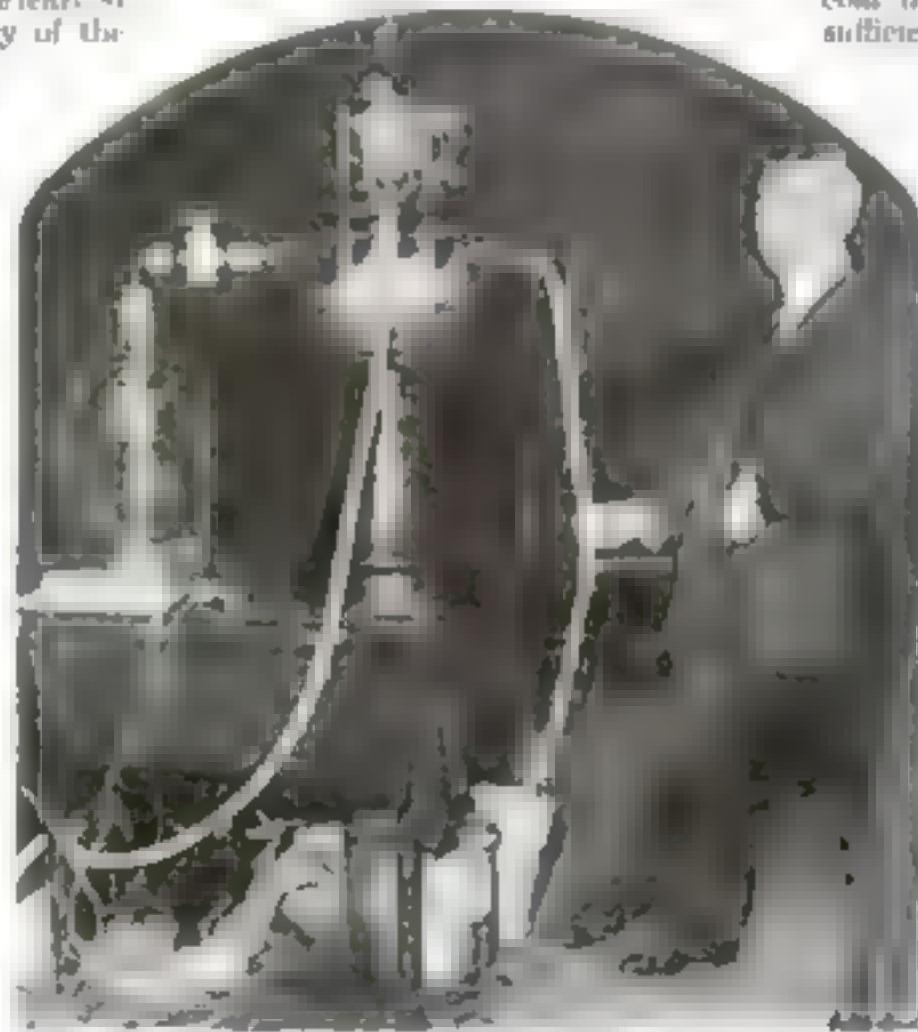
AT ABOUT the same time, during the inauguration of a transoceanic wireless service between England and Canada, using the new Marconi beam system of transmission, Senator Morgan predicted that radio waves concentrated in a directinal beam, like the beam of a searchlight, eventually may be used for the transmission of power. The inventor of wireless predicted the day when cities may be lighted without wires, and when electric power may be carried from waterfalls to towns and factories without the need of cables.

Recently, too, experts of England, France, Germany, Japan and America, at the International Conference on Bituminous Coal at the Carnegie Institute of Technology, Pittsburgh, Pa., were revealing new discoveries in the production of synthetic gasoline and oil,

products. From a ton of dry coal he claims to have obtained 140 gallons of crude oil which, when distilled and refined, yielded forty gallons of motor fuel, fifty gallons of Diesel engine oil, thirty-five gallons of fuel or creosoting oil, a pitch residue, and, in addition, 10,000 to 12,000 cubic feet of gas.

Another fuel expert, Dr. Gustav Egloff of Chicago, asserted that the bituminous coal deposits of the United States are sufficient to supply the world with motor

fuel for 800 years. This fuel, produced by low-temperature distillation of coal tars, he added, "will give more than double the mileage per gallon of fuel when compared with ordinary gasoline in operating a high-compression motor."



Would Draw Power from the Ocean Depths

Prof. Georges Claude noted French inventor demonstrating a working model of the generator with which he proposes to obtain power from the difference in temperature between the tepid water at the surface of tropic seas and the cold water 3,000 feet below

as well as revolutionary economies in the distribution and consumption of coal resources. They pictured the engines of industry and transportation eventually propelled by cheap synthetic oil, and cities free from coal smoke.

Among them were the German scientists, Prof. Franz Fischer and Dr. Friederich Bergius, both of whom have invented methods of producing oil from coal. By obtaining carbon monoxide gas from coal, Dr. Fischer reported that, adding hydrogen, he was able to obtain many artificial oils, including gasoline and lubricating oils.

Dr. Bergius' method is to reduce coal to paste and combine it with hydrogen at high temperature and pressure. The resulting fluid, he declared, has all the properties of crude petroleum, from which can be obtained gasoline and other oil

products. The possibility of distilling coal at the mine, recovering the valuable oils and gas, and then transmitting these by long distance pipe lines to consumers was forecast by Harold Nelson of London. Along similar lines, Walter E. Trent, a mining engineer of New York City, revealed a new process of converting solid coal into a liquid. The coal is pulverized to the consistency of talcum powder which, when heated, becomes fluid and runs like water. This coal oil, Mr. Trent declared, eventually will be used in place of gasoline in engines at a cost of six cents a gallon, and will revolutionize mining, transportation and consumption of coal.

In short, chemists, fuel experts and engineers all seem to agree that we are at the beginning of a new era in the use of coal resources. They say that in a few years it will be considered a criminal waste to burn raw coal for heat and power.

The winds and the sun are other possible sources of future power. Anton Flettner's experiments with rotor ships illustrate the efforts of science to capture the winds. That inventors may find a way to harness the sun when they know more about photo-electricity was the recent statement of Dr. Herbert E. Ives of the Bell Telephone Laboratories, New York. "It is probable," said Dr. Ives, "that the utilization of the sun's radiated energy by vegetation is primarily induced by photo-electric response. We may, by advancement in knowledge of photo-electricity, master ultimately the utilization of solar radiation, though we may have to resort to the indirect method of nature."

**A Thrilling Battle for Life**

Four remarkable microphotographs showing dramatically the victorious struggle of a single living cell to perpetuate itself. To arrest its whirling motion of division, opposite sides of the cell were caught by fine needles. Notice how the cell tore itself away from the needles. Right: One of the latest types of microsurgical instruments.

Amazing Experiments Reveal Secrets Hidden in Our Bodies

*Invisible Life Cells, Only 1-3000th of an Inch Long,
Dissected with Marvelous New Surgical Instruments*

By EDGAR C. WHEELER

I HAVE just come from the most astounding operating room in the world. I have seen a scientist take a living creature smaller than the finest speck of dust in the air—so small that thousands of them might rest comfortably on your thumb-nail—and perform an operation upon it, much as a doctor might operate on a human patient! With needle points too fine and delicate for human hands to manipulate without the aid of precision instruments, he probes into the microscopic secrets of the smallest unit of life we know on earth—the single living cell. Into one of those cells, so minute that it can be seen only through the powerful lenses of a microscope, he injects chemicals, just as a physician injects drugs into a human patient with a hypodermic needle, and watches the reactions.

The "surgeon" who performs these wonders—and he is one of a number of scientists today who are doing much the same thing—is Dr. Robert Chambers of the Cornell University Medical School in New York City. His achievements are astonishing enough in themselves. Their real significance, however, is that they are not only disclosing new knowledge to combat disease and prolong life, but are bringing nearer than ever before an answer to the greatest riddle of the universe—the secret of life itself. For they are giving us new glimpses of the wonderful structure and habits of the very foundation bricks of life—the minute jellylike specks of energy of which you and I and every other living thing are made.

The men who, like Dr. Chambers, are devoting their lives to the study of individual life cells, have learned some surprising things about them.

They have discovered, for one thing, that the countless microscopic parts of which you are made are potentially immortal; under right conditions, they would live forever. In the laboratory these men are revealing, too, the chemical changes and conditions within the cells which, they believe, are responsible for old age, disease and death.

There are thousands of different kinds of living cells. In the lowest forms of life, single cells sometimes live by themselves. Such creatures are found in the sea, or creeping along the bottoms of muddy ditches. Such, too, are various kinds of disease bacteria, although these sometimes gather in colonies.

But in the higher forms of life—human beings, and animals and trees—the body consists of an intricate combination of microscopic cells, each assigned a definite place and performing its own allotted task in the whole structure. Your body contains more than a thousand billion of them. Every bone, every drop of blood, every part of your flesh, is made up of countless numbers of cells.

AND every cell is composed of the strange stuff called protoplasm, a clear substance which, when seen under the microscope, resembles the jellylike part of white of egg. These tiny droplets of jelly appear, at first sight, to be featureless; without character, organs, or internal division. Yet, astonishingly, each one constitutes in itself an entire organism, or being, capable of performing all the complex functions of life, such as sensation, eating, reproduction, excretion and spontaneous motion. Indeed, it is the seemingly characterless protoplasm in our bodies that enables us to see, hear, feel, grow and act. It is the only known thing in the universe that really does what we call thinking.

The living cells of protoplasm are little storehouses of energy. As with our bodies, when properly nourished and stimulated, this energy exerts itself in performing useful work. Under the microscope a single cell may be seen at its most important task—that of renewing and perpetuating itself. This it does in a marvelous way, by dividing to form two complete cells where one was before. These in turn divide. And so, on and on, the life force continues its process of renewal.

That is how every living thing

What It Means to Us

WHILE the new discoveries made possible by the remarkable microsurgical instruments recently devised do not offer us any promise of living forever, even if we should wish to do so, they are revealing knowledge which promises to aid immeasurably in making human life healthier and happier over a greater span of years than ever before. Already they have revealed astonishing facts concerning the causes of old age, disease and death.

Enormous efforts have been made in recent years to discover the secrets of life hidden in these microscopic lumps of protoplasmic jelly, ten thousand million of which make up each of our bodies. The results of these efforts, as Mr. Wheeler tells them here, are of vital interest to every one of us.

grows. That is how our bodies grow, from a single unit of energy to a marvelously complex mechanism of thought and action. And that, scientists believe, is how all the crowded life of the earth has come into being.

"If a single cell, under appropriate conditions, becomes a man in the space of a few years," said Herbert Spencer once, "there surely can be no difficulty in understanding how, under appropriate conditions, a cell may in the course of untold millions of years give origin to the human race."

It is to discover something of the chemical processes that underlie this ceaseless stream of life that Dr. Chambers and others are probing the bodies of single cells under the microscope.

THIS invincible power of the life force was remarkably demonstrated in a recent experiment by Dr. Chambers. His subject was a single egg cell from the sea, less than a thousandth of an inch in diameter. Thus he placed under the microscope. The cell began the process of division, creating within its own substance two opposing streams in the form of tiny whirlpools. As it did so, Dr. Chambers caught up the opposite poles of the cell with extremely fine needles and stretched them out in an attempt to arrest the whirling motion of division. But the tiny unit of life would not be denied.

Instead of surrendering, it tore itself viciously away from the needles which held it, and so fulfilled its destiny. Astonishing photographs showing the dramatic struggle and victory of this microscopic creature are reproduced on the preceding page.

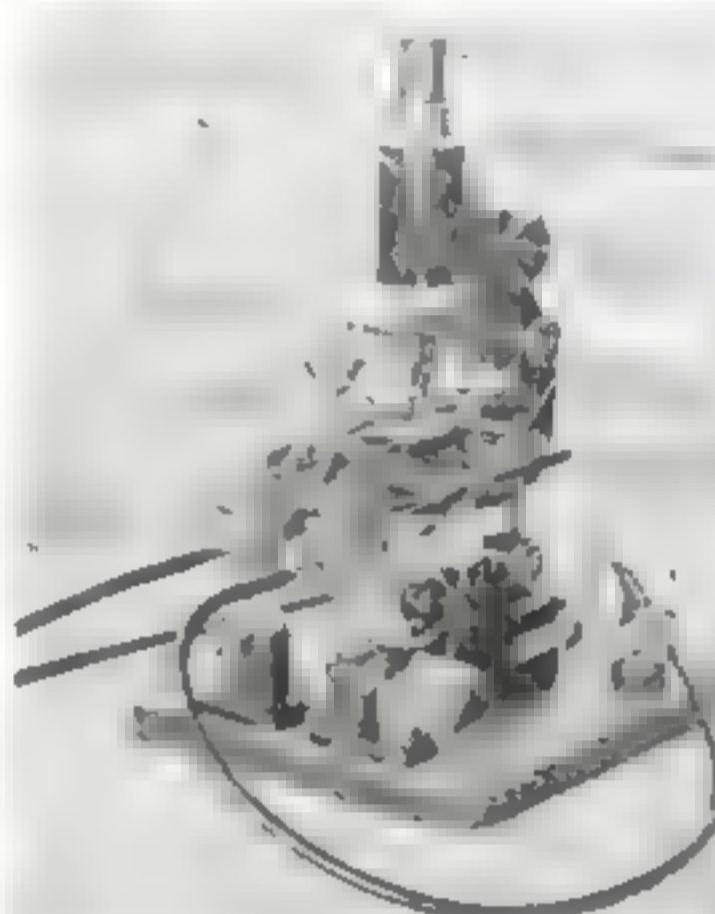
In another experiment Dr. Chambers made a time exposure of a single cell while it was beginning to divide. The resulting photograph showed clearly the circular motion of microscopic granules contained in its substance.

"IN ITS action, the living cell," Dr. Chambers told me, "seems to be like a tiny electric battery in which current is generated by the chemical action of an exciting liquid. Inside the cell is a central portion, or nucleus, which seems to be the inmost seat of the life forces. This is alkaline in its chemical characteristics. Surrounding the nucleus is an acid substance. This, in turn, is enveloped in a thin coating, or membrane, and the surface of the cell is bathed by the blood stream, which again is an alkaline solution. Here then, we have a combination which may be capable of generating energy by electrochemical action."

One important significance of these discoveries by Dr. Chambers is that they tend to bear out the fascinating theory that the basis of all life and all matter is electricity. They were made possible by his invention of a wonderfully delicate instrument which enables him to inject from a syringe microscopic drops of chemicals into the heart of the cell. By observing changes in the color of the

injected chemicals, he can determine the chemical characteristics of the cell substance.

His discoveries recall, too, experiments conducted by Dr. W. R. Whitney, director of the General Electric Company's research laboratory, in which Dr. Whitney demonstrated the similarity between human nerves and an electric current by means of an "electric nerve," the vital part of which was a photo-electric cell. The eye of a frog when exposed to candle light, he reported, will generate current



The Cell-Surgeon's Instruments

This is the incredibly delicate micro-manipulating instrument devised by Dr. Robert Chambers, of New York City, with the aid of William Parham. Using one of the needles as a pipette, Dr. Chambers has injected chemicals into living cells so minute that they can be seen only through the powerful lenses of a microscope. His experiments led to new discoveries concerning cell structure

easily measured on a galvanometer.

"In fact," said Dr. Whitney, "all living tissue responds to stimulation by producing electric currents."

Dr. Chambers, in his experiments, obviously cannot use living cells of human tissues. Instead, he uses mostly egg cells from the sea. "For these cells," he says, "are bathed and nourished by waters which have the same chemical properties as the human blood stream, that is why the life of the ocean is so abundant." With the delicate needle points of his newly devised instrument, however, he has been able to dissect from the blood a red corpuscle only three thousandths of an inch thick. He expects that his instrument will be of value in studying the effects of different drugs on disease germs and the body cells which they attack.

The new science of probing the secret foundations of life is only in its infancy. Other research work at the Rockefeller Institute in New York and at the Institute for Biological Research at Johns Hopkins University, have revealed the power of living cells to perpetuate themselves indefinitely.

Fourteen years ago, for example, scientists at the Rockefeller Institute

determined to see how long a bit of the heart of a chicken still in the egg, unborn, would live if it were put all on its own and received careful attention. They placed it in a glass jar, and surrounded it with proper nourishment. The original cells have disappeared, of course, but their descendants are there still, thriving and multiplying by division with every indication of continuing so indefinitely. Yet the embryo chick from which that heart originally came, had it been born, would have died long ago.

Another astonishing experiment was the recent growing of a normal chicken's eye from bits of embryo by the Royal Society in London. Still other experiments at Johns Hopkins Institute have led Dr. Raymond Pearl, the director, to declare that the cells of the human body are potentially immortal when they are placed separately in conditions where they are supplied with the right food, and where their waste products are removed.

BUT if scientists can make these cells live on and on, why, you may ask, do we grow old and die?

The reason, they tell us, is that the countless cells which compose our muscles, nerves, bones and blood are combined in a bodily machine so complex that death is the price you pay for having it. In this complicated structure the individual cells are not free to go on living their own little lives, unmolested, but are dependent for existence on countless other cells, each performing some special function. So it is that an injury to one part of your body may wreck the whole wonderful machine. Or poisons and enemy germs may find an entrance and play havoc with the smoothly working mechanism.

To discover just how to prevent these poisons from accumulating in the cells and how to aid the body in fighting off disease, is the ultimate goal of the men who have found a means of dissecting cells.

THIS story of how this new science has been developed is a romance in itself. The man who first conceived the idea of manipulating individual cells under a high powered microscope was an American scientist, Dr. M. A. Barber, of the University of Kansas. When he began his experiments nearly twenty years ago, the chief problem confronting him was that of obtaining a needle fine enough to handle the tiny speck. No ordinary needle would do, for the point of the finest sewing needle is as broad as a house compared with the size of a cell. To attempt to prick a living cell with it would be like trying to pick a nut with a pile driver. It would simply smash the cell.

The instrument which he finally invented for the purpose was the point of a glass thread finer than a hair. To make it he softened a glass tube at the center by heating it in a flame, then suddenly stretched it out into a thread. He broke the thread, and one of the threads gave him the fine needle he required.

The next

(Continued on page 148)

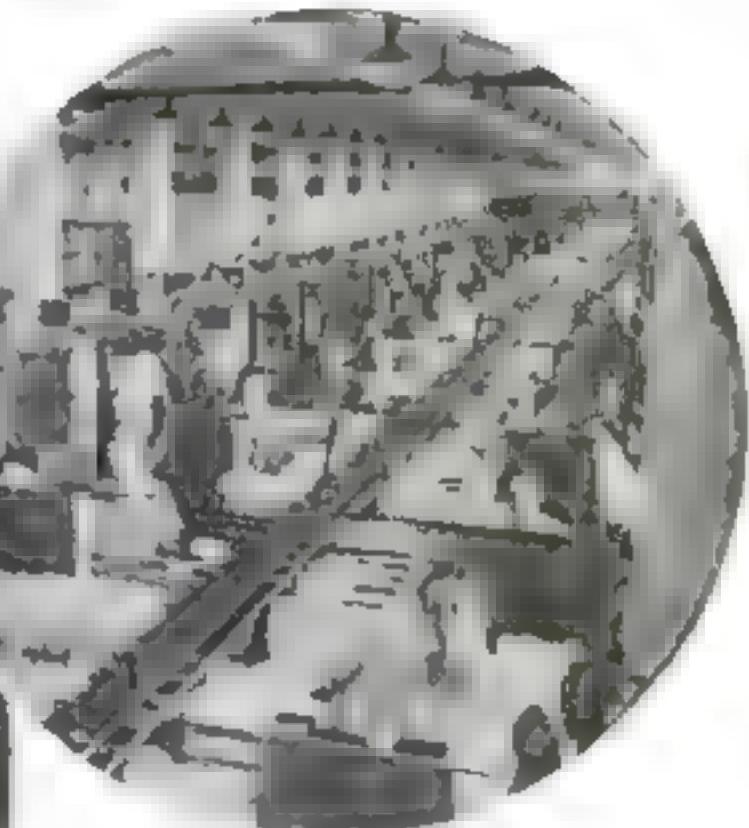
Nature's Wonderful Building Bricks

How Vegetable Fibers Supply Us with Homes, Clothing, Paper, and a Million Other Needs

By
Louis E. VAN NORMAN

Future Rope

From the tough fibers of hemp we get much of our rope. Above: Men going carrying a bale of hemp to market. At right: Stripping the skin of the hemp plant.



Artificial Silk from Plants

A view in a modern rayon factory, where vegetable fiber is transformed into gauze stockings and many other useful articles. Rayon has revolutionized the making of clothes. More than 200,000,000 pounds of it were produced last year.

Mr. Van Norman, the author of this article, is a Commercial Attaché of the Bureau of Foreign and Domestic Commerce, United States Department of Commerce.—The Editor

"OUR modern civilization hangs on two slender threads, as slender as a strand of silk or a bit of tissue paper. And both these strands of threads are made of bricks."

We were strolling—not long ago—across the piazza of one of the North Italian cities, an industrial chemist and myself. My companion, a keen young Milanese, pointed to a handsome new building just going up. We had been talking about a new vegetable silk which was being made in Italy.

"Il Duce—the great Mussolini," he observed with a smile, "has persuaded these fellows, these bricklayers, to work an hour more a day for the glory and profit of Italy. But they can't lay bricks as fast as we can in our factory. And they can't make as many different and wonderful things with their bricks as we do with ours."

"You've got me," I replied. "What's the answer? I did not know that your firm used bricks. I thought you made a new kind of silk called rayon."

The chemist smiled again. "Yes, we do," he observed calmly, "but we make it out of bricks."

"Tell me about it," I urged, but he caught my arm again. "Here," he said with a twinkle in his eye, as he dropped

a few centesimi into the outstretched hand of the newsboy. "Here," handing me the evening paper. "This is made of bricks, too."

"House, silk, and newspaper—all made of bricks!"

"Yes," he smiled, "and many, many other things, too. But we must divide the bricks into two classes: those made by nature and those made by man."

Over our lunch we chatted. He told me the fascinating story of vegetable bricks out of which the ingenuity and industry of man is constructing such a bewildering list of things for his need, comfort and pleasure.

"Did you ever stop to think," asked my Italian professor acquaintance, "that the fibers and cells which make up the principal parts of flowering plants are really nature's bricks and mortar? Perhaps you did—although I doubt it. But I am sure you have never realized just how many truly wonderful things modern machinery, guided by the industrial chemist, is fashioning out of these bricks."

FROM fiber as a raw stuff, he went on to explain, we get cellulose, a sort of "mother stuff." We sort the bricks and discard the mortar—making new connections of our own. Built up on this is an ever expanding list of paper products, and the many moisture-resisting compounds out of which we are fashioning all sorts of containers and nonconductors, our celluloid and gun cotton. But most

important of all, perhaps, we get the beautiful fabrics and textiles from which we make the clothes we wear and the wrappings for our boxes, bags, and other receptacles for transporting goods.

"It is really wonderful," he said, "what we make out of these bricks. Your daily newspaper, the letterhead and blotter on your desk, the 'cardboard' carton in which the morning cereal reaches you, the milk container, your waste basket, the covering which keeps the electric wiring in your walls from setting fire to the house and protects your telephone wires, the wardrobe trunk in which your wife keeps her traveling things, and your daughter's new silk dress! All these are made of fiber, the same 'mother substance' which the modern chemist, like the genie of Aladdin's lamp, has commanded to appear out of various forms of vegetable fiber."

"YOU mean that any kind of plant furnishes us with this fiber, these wonderful vegetable bricks?" I asked.

"No, not exactly. But the list of those plants which do furnish the basic material for cellulose is quite large already. And it is lengthening all the time. The principal plants now are: cotton, the most important, followed by flax (linen), hemp, jute, esparto (a variety of North African grass), bamboo, straw, cornstalks, sugar cane, wood pulp (from such soft wood trees as the spruce and hemlock), papyrus, china grass (ramie), even cactus, and sage brush, and a few newly introduced plant substances of a minor but growing importance."



Mountains of Wood for Paper

Twenty-five thousand tons of wood pulp will be in storage at a paper mill in New York. That is at the top looks like a big mountain. So rapidly are the forests being stripped of pulp wood that soon new fibrous materials will be necessary to supply our demands for paper.

"Of course, we all know paper and some of the principles of its manufacture. Paper is an old friend of the human race. But," I queried, "what has paper to do with some of these hard fibrous substances you have just mentioned?"

"IT'S a long story," he said, "too long to tell here. But it has come to a division of raw material between the textile weaver and the paper maker. The latter uses what the former throws away. The spinner of yarn for textiles must have long and strong fibers. And so he tries to build up the separate fibrous elements into thin, tough lengths, such as cotton, jute, hemp, sisal, flax. The paper maker, on the other hand, wants a pulpy mass with all the elements reduced to their smallest size, so that he can make a sheet or web of varying thickness and strength. When he uses rags as his raw stuff, he finds that the textile maker has already done part of his work for him."

"The natural bricks we get from plant fibers we make into cellulose. Never mind the long chemical formula of this. It is, in simplest terms, a 'carbohydrate.' This particular carbohydrate is what the chemist calls inert, and that is why we can make so many uses of it."

"I don't understand."

"Well, let us translate it into terms of character. An inert substance is unresponsive and obstinate. No one can crystallize it. Further, it gives a strong matter quite readily. In fact, cellulose resists all action by chemicals, except in the case of one or two so-called solvents which turn it into what the chemists call a viscous compound. This compound can be forced mechanically, at high pressure, into the form of fine threads. And from these threads we make the now famous rayon fabric. When the natural vegetable bricks



Walls of Sugar

Fibers from various kinds of plants are being substituted more and more for lumber in buildings. The house above is sheathed with heat-insulating fiber board manufactured from sugar cane.

the paper or the textile route. All that is necessary is that the original bricks—the fiber—be reclaimed, and made available for the construction of new things. And how full of real human interest this journey is!

LAST summer, on the outskirts of Bucharest, the Rumanian capital, I saw a little dark-eyed gypsy girl, with a form like a bronze statue. She lay sunning herself by the dirty little stream that winds through the city. Her skin was clean, but the rags she wore as clothes were in desirably tattered and dirty. What posed as a skirt was made of something which had once been a fresh dotted calico or print. Could this remnant possibly be of any further use to the world?

A representative of the Y. W. C. A., who was looking on, told me that this ragged skirt (which she herself had given the child) was of American cotton, spun and woven in England. Was it by a dramatic coincidence that on the same day statistics from Washington

informed us that an increasing proportion of the old rags used in fabricating fibre trunks were coming to American factories from this part of the Old World? Perhaps it was. At any rate, when a few days later I met in a shop, on the fashionable street of Bucharest, a lady of the Court purchasing an American wardrobe trunk, I permitted myself to piece out the story something like this:

ACOTTON planter in one of our Southern States, say Louisiana, sends his bales from New Orleans to Manchester, England. The English mills make up a cheap printed calico, which a drummer sells in Prague. There my acquaintance of the Y. W. C. A. finds the bit of goods, which she afterwards makes up into a petticoat and gives to the little Rumanian gypsy. When this has become too dirty and shapeless for even a Zigan girl, it is thrown into the canal-like river which runs through Bucharest. Other gypsies fish it out and sell it to a Jewish agent who gathers great quantities of such rags, and periodically sells them to dealers in New York.

The rest of the process can be seen in many a factory. It is merely one of American mechanical skill to wash, macerate, chemically treat, dry, pressing



Harvesting Straw in a Grain Field of the Middle West

Rags, paper, cardboard, mats and baskets are just a few of the useful articles that come from the fibrous stalks of wheat, rye, oats and barley. Photograph shows how machines harvest straw, a valuable farm by-product.

To the Moon at 7 Miles a Second!

*Engineers Plan Strange
New Five-Ton Rocket*

By H. C. DAVIS

WHEN Charles Fitchugh Tolman prophesied in last month's POPULAR SCIENCE MONTHLY the marvels of meteorology we may see in 1927, one of the possibilities he mentioned was that Prof. Robert H. Goddard of Clark University might perfect his long-awaited motor rocket.

Man's fascinating dream of reaching the moon is progressing from a Jules Verne fancy to a cold problem of mathematical and engineering calculations. That such a feat is considered within the range of possibility is evidenced by the activities of scientists in Europe as well as in America. Two of them, Prof. Hermann Oberth and Dr. Franz Hoell of Vienna, are constructing a five-ton rocket ship in which they hope to reach the moon in two days. Already they have experimented with small model rockets which are reported to have reached altitudes of several miles, returning to earth by means

of parachutes which opened automatically when the rockets ceased their climb.

Another project is that of Max Valier, young Austro-Bavarian astronomer and aviator who is now at work on a rocket-driven "space ship."

All of these plans are based on virtually the same principle. Each proposes a projectile-shaped ship propelled by the instantaneous combustion of fuel which it carries. The reaction or "kick-back" from the blast of exhaust gas, they calculate, would drive the rocket at terrific speed.

Professor Oberth's design, for example, calls for a triple rocket in one unit; that is, the shell of the rocket would contain three explosive chambers in the rear, the first carrying alcohol, and the other two liquid hydrogen. Such a rocket, he estimates, could exceed a speed of seven miles a second. As the rocket pro-

Whizzing through Space

Now that the North Pole has been conquered, another world-wide adventure is starting in space exploration if man has enough courage. Here is the artist's conception of the moon-bound vehicle which American is hoping to be the first to make the attempt—start from the huge nose of the

grossed, its speed would be increased by dropping off the shells of the exhausted explosive chambers, lessening the weight.

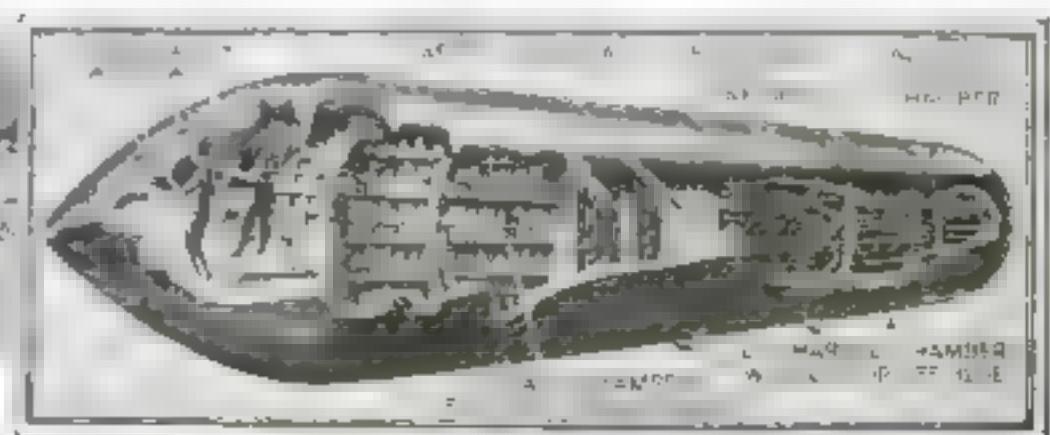
What would it be like to travel through space in a ship of this kind? In the first place, once the regions beyond gravity had been passed, the passengers would float like spirits in mid-air—a detail the moon voyagers have provided for by supplying straps with which the passengers will be fastened to the walls. Since no liquids would flow, the passengers would be forced to suck their drinks from bottles through rubber nipples!

HOW the rocket could make a safe landing on the moon, or how the return voyage could be accomplished are problems apparently unsolved. Dr. Hoell, however, has invented an ingenious steering device to guide the rocket and prevent it from wandering aimlessly in space.

A few weeks ago a number of astronomers, engineers and physicists, meeting in Vienna, formed a Society for the Exploration of the Universe to promote Oberth's project. The initial plan on its program is to shoot a flashlight rocket to the moon and observe its expansion through a telescope.



Drawn by
Edgar Wardlow



Cross section of Professor Oberth's proposed ship, showing the pilots' cabin in the nose and explosive chambers in the rear. Its tremendous speed of seven miles a second would be increased still further by dropping off the shells of the exhausted alcohol and hydrogen rockets, the head then rushing on by itself.



Safeguarded by Science

While deep sea diving always will remain exclusively the job of fearless men, much less science is rubbing it of its most hazards. Above, a diver in full equipment

ALEXANDER LAMBERT, famous British deep-sea diver, was at work salvaging gold from a sunken vessel when, at a depth of 165 feet, he became suddenly aware that his diving suit was dangerously over-inflated with air. By instinct he reached to open a valve in his metal helmet that would let the surplus air escape. He was too late.

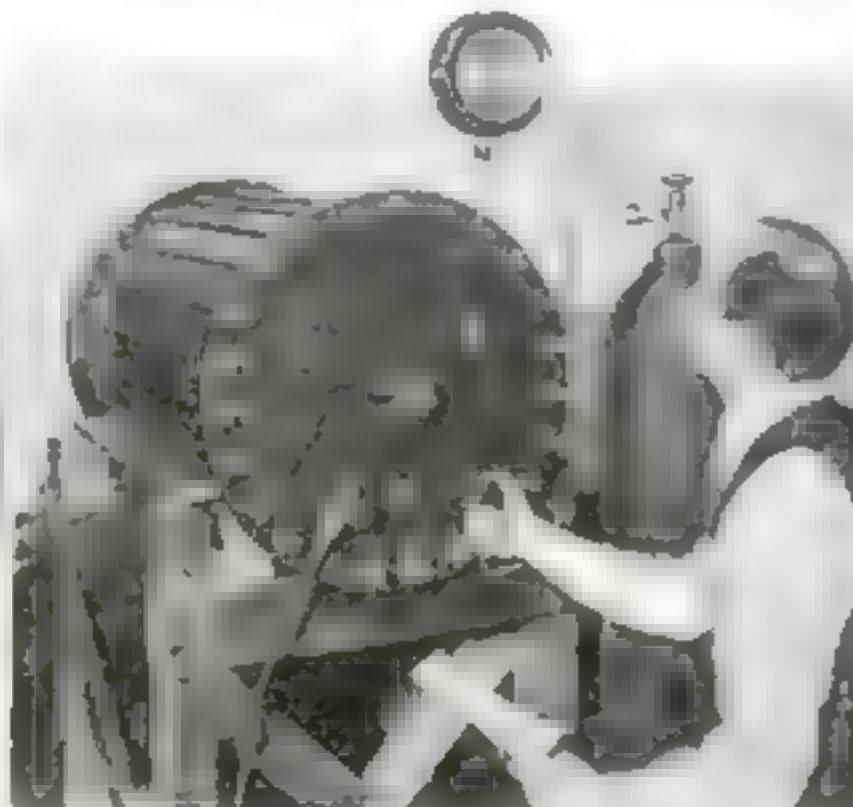
Before he could touch the valve, his weighted feet left the ocean floor and he shot upward like a gas-filled balloon. He was helpless. Once begun, the mad journey became increasingly swift as the pressure of water lessened and the air in his diving suit expanded. Almost before he had time to think, he was catapulted to the surface. There he bounded, head downward, unable to right himself. In the language of divers, he had "blown up."

Quick action by tenders on the diving boat was all that saved Lambert from death. But they were powerless to save him from a fate almost as terrible. The sudden change from heavy air pressure in the deep to normal pressure at the surface had the effect of paralyzing him for life. He fell victim to the disease known as the "bends," most dreaded of the perils that divers face when they explore the bottom of the sea.

THIS strange malady, which cripples or kills countless submarine workers, is a peril which, more than any other, has hampered speedy undersea construction or salvaging operations. In recent years scientists and inventors have tried to find an effective remedy. Now success appears to be in sight. For they have hit upon the idea of mixing helium, the non-inflammable gas used for inflation of airships, with oxygen, and substituting this mixture for the compressed air which ordinarily is pumped to divers, working be-

Man's New CONQUEST

Helium Enables Divers to Explore Ocean's Bed at Greater Depths



Marks Turning Point in Diving History

Divers who breathe a mixture of helium and oxygen can work safely at greater depths and for longer periods. Bureau of Mines tests show the first experiments as shown above were made by placing small animals in a decompression cylinder simulating diving conditions.

neath the surface. Not only will this helium-oxygen atmosphere aid in preventing the bends, they say, but it will enable divers to remain submerged for longer periods of time and to descend to depths heretofore impossible. The present extreme limit is about 300 feet down.

THE conditions which cause the bends are fairly well known. Broadly speaking, the disease results from the tremendous pressures to which the diver's body is subjected. Air at pressure slightly above that of surrounding water must be pumped into his diving suit to enable him to work at great depths. The air which surrounds us normally exerts a pressure of about fourteen pounds to the square inch. For every two feet that a diver descends, this pressure is increased one pound a square inch. At a hundred feet it becomes about fifty pounds to the square inch, equivalent over the entire body to a weight of nearly fifty tons. Only a sturdy body can stand the strain.

The real danger lies not so much in actual submersion as in the chance of too speedy ascent, with sudden change from high to low pressure. This causes a wrench to the human mechanism which is beyond endurance. What happens is that nitrogen gas, absorbed from the air by the body at high pressure, forms bubbles in the blood and tissues when the pressure is suddenly released, much as "soda pop" bubbles when the bottle containing it is opened. Excruciating pain is the result. If the bubbles are formed in the spinal cord or brain, they may cause paralysis or death.

In the new remedy the nitrogen, which constitutes seventy-nine per cent of natural air, is replaced by helium gas, which, it is said, will not form dangerous bubbles.

THE method is the result of long research by the Navy, the Public Health Service and the U. S. Bureau of Mines. Their investigations have included tests in a large pressure chamber installed in the Pittsburgh experiment station of the Bureau of Mines. The chamber is filled with helium-oxygen atmosphere, and is equipped with electric lights, telephone, windows, and control apparatus, all designed to withstand test pressures as high as 1,000 pounds to the square inch.

Twice the experiments were interrupted by emergency calls for supplies of the helium air for use in actual diving operations. One of these occasions was during the salvaging of the submarine *S-51*, rammed and sunk off the coast of Rhode Island. Here helium was used successfully in emergency treatment of divers who showed symptoms of the bends.

At present, if a diver comes to the surface too quickly, either as a result of some accident or of his own impatience, almost his only hope of escaping the bends is recourse to "The Iron Doctor." This is a decompression chamber, an air-tight room in which the diver is given atmospheric pressure of gradually diminishing strength, allowing him to adjust himself to the outside pressure by easy stages.

MANY times the Iron Doctor has been a life-saver, but never more dramatically than during the desperate attempts of divers to raise the sunken submarine *F-4* at Pearl Harbor, Hawaii, when one Navy diver barely escaped with his life and another became a hero.

Diver W. F. Loughman, chief gunner's mate, was working 250 feet down when his lines became fouled. The men above caught his signal of distress—three sharp pulls on his life line. They tried vainly to raise him. He was stuck.

In the emergency Chief Gunner Frank Criley, a skilled Navy diver, went down to the rescue. He found Loughman badly tangled and all but helpless. For more than an hour Criley struggled to free his comrade. When at last the lines were

of the DEEP

By NORMAN C. McLoud

cleared he was forced to return to the surface for a new line to replace one that he had been compelled to cut. Ignoring the danger of diving a second time without an interval of rest, he immediately returned to Loughman, adjusted the new line, and signaled for the rescued man to be hauled up. Then he himself emerged and entered the Iron Doctor to ward off an attack of the bends.

Meanwhile, orders had been issued to bring Loughman up slowly to allow his body to adjust itself to decreased pressure. Accordingly, when he had reached a depth of a hundred feet the tenders stopped hauling in the line. They failed to reason, however, with the impatience of a man who had been trapped for hours in a diving suit. Loughman began climbing up the ladder which hung from the side of the salvaging vessel. Fifteen minutes later, having reached a depth of forty feet, he collapsed.

THREE was only one thing to do. That was to bring him up quickly. By all rules, the trip to the top should have taken five hours; actually it took forty-two minutes. This meant that Loughman was in grave peril. To make matters worse, the one available Iron Doctor was occupied by Crilley. It was decided to treat both men at once, despite their different needs.

When Loughman was placed in the chamber he was like a dead man. For two hours he remained under treatment in the chamber, yet even this did not ward off the bends, which kept him in the hospital for more than two months. Crilley, after five hours in the Iron Doctor, recovered completely.

In the life of every deep-sea diver such narrow escapes are all in the day's work. While improvements in equipment, including underwater telephones, searchlights and cutting torches, have lessened the dangers, still there remain countless unseen hazards and pitfalls that never can be reckoned with.

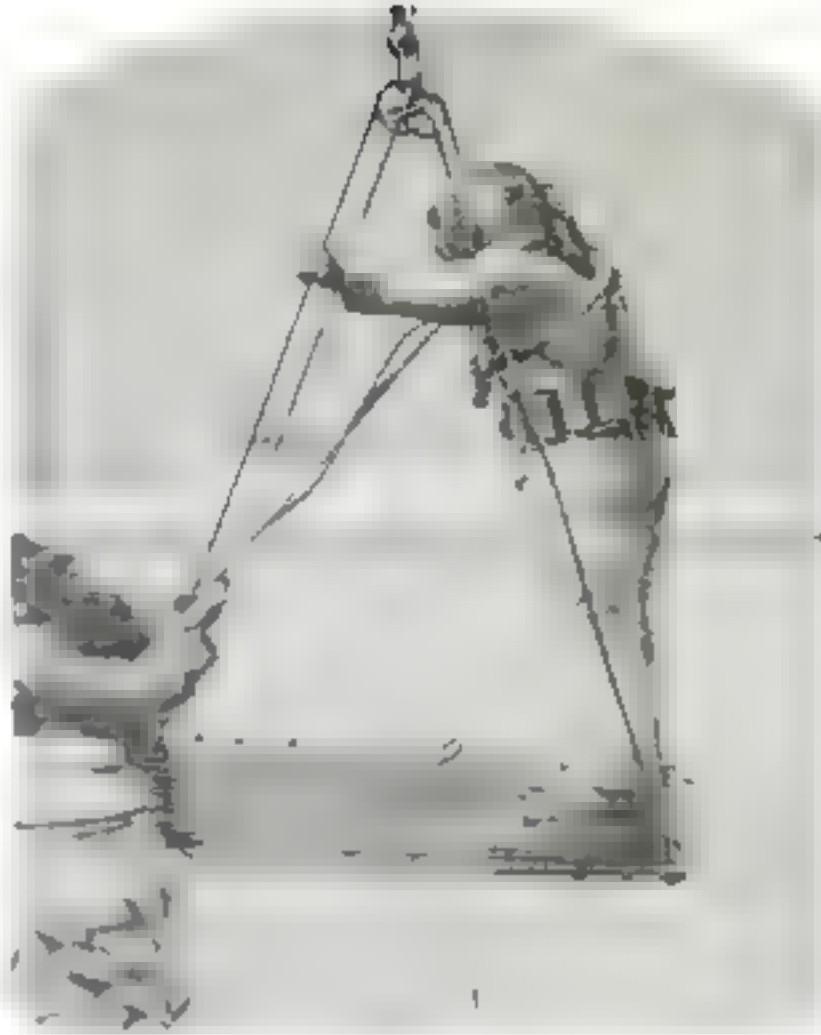
THE divers, for example, who salvaged more than \$27,000,000 worth of gold from the White Star Liner *Lusitania*, sunk off the coast of Ireland in 1917, had to battle with terrible gales, shifting sands, and a continually moving tangle of wreckage. To recover buried bars of gold they literally wore their fingers raw digging with their hands into the closely packed sand of the ocean bed.

One strange mishap during these operations is recalled by Lieut. Commander E. L. B. Damant, a member of the crew of the salvage ship *Rover*.¹

"To prevent the air pipes from dragging on their helmets and hampering their work," he said, "the divers were accustomed to tie the pipes to the wreckage, leaving themselves a certain amount of slack. One day a diver was working head downward when the trousers of his suit became inflated with air and he started to rise upside down. Halfway between the wreck and the surface he was halted by his airline, and there he was suspended, upside down.

"On the deck of the ship we heard his muffled voice over the telephone: 'There's water running into my helmet,' he was saying. 'Be as quick as you can.'

"Another diver went down. Standing astride the leaked air line, he cut it loose. Instantly both men shot to the surface. The severed line had dragged the rescuer along with the man he had freed."



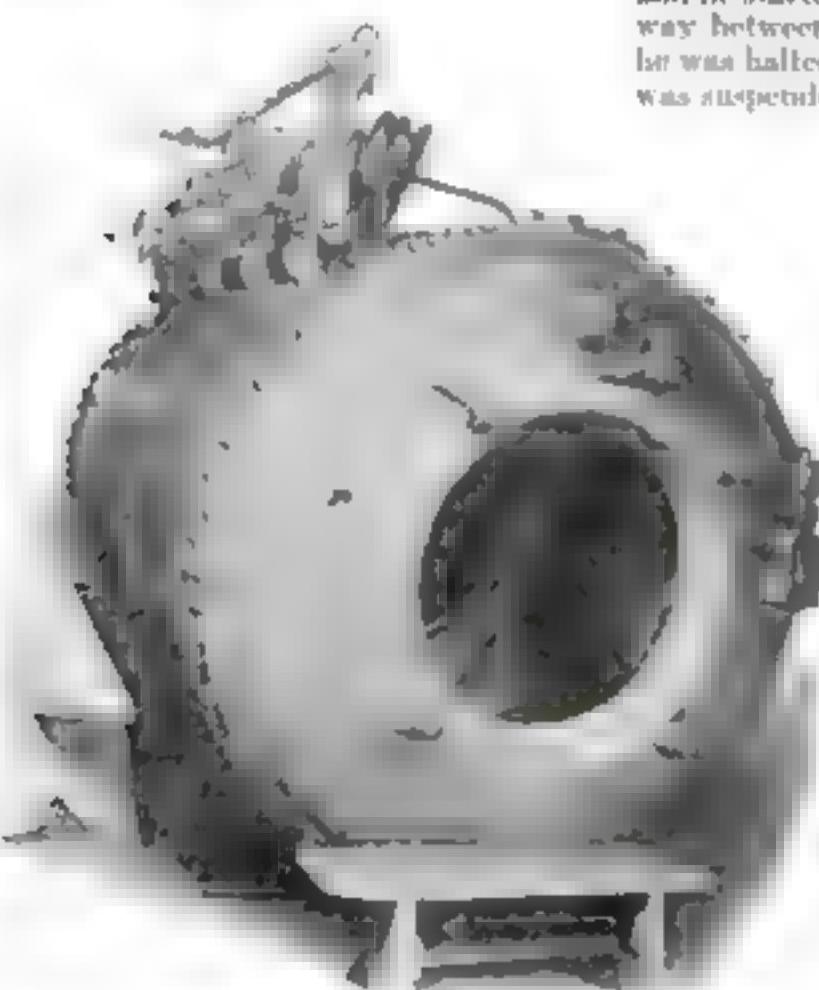
Lowering a Diver for His Day's Work

Descending and ascending must be done in slow stages, or compressed air sickness, paralysis, even death may result. This is now done by means of a metal platform lowered over the side of the barge. Note the heavily weighted feet of the diver, to help him maintain his equilibrium while working under the sea.

Of all the skilled divers of Uncle Sam's Navy, the man who might well claim a record for close calls is Chief Torpedoman Francis Smith, one of the heroes in the salvaging of the *S-51*. His feat of saving himself from a cave-in of sand while digging a tunnel under the hull of the sunken submarine remains one of the most amazing adventures in the annals of the undersea. Not only did he wash himself out of the sand which buried him, using the powerful stream from a fire hose with which he had been digging the tunnel, but once free, he immediately went back to work in the hole which had almost been his grave.

AGAIN, in Sturgeon Bay, Lake Michigan, where divers were at work on the wreck of the steamer *Lakeland*, Smith found himself entangled in a mass of floating, sodden rope that had drifted into the engine room. It clung to him like tentacles, enmeshing him until he was unable to move. He telephoned to his tenders to send down a knife. After moments of suspense the knife reached him at the end of a rope, and he finally cut his way clear of the trap.

Of the same stamp is "Big Harry" Rheinhartsen, another of the crew that grappled with the *S-51*. The most treacherous bottom he ever explored, he tells us, was that of Lake Parappanong, a supply reservoir near Boonton, N. J. There, some months ago, he undertook to recover the body of a game warden who had been drowned. Farm lands had been flooded to form the reservoir, and the bottom was strewn with fallen trees and wreckage. Eight times he plunged into icy waters, risking his life at the very spot where another diver, Johnny Hoar, had met (Continued on page 244)



Test Tank for Helium "Air"

In this giant tank several divers voluntarily subjected themselves to Bureau of Mines tests to determine the value of the new helium-oxygen air in modern diving operations.

What Can You Make of Those 14 Puzzling Pieces?

Test Your Skill in Our Fascinating Archimedes Prize Contest



The Howling Dog—First Prize
F. A. Van Wormer, Yamhill, Ore.

IF OLD Archimedes could journey down the years from ancient Syracuse, and could witness the ingenuity of present-day readers of *POPULAR SCIENCE MONTHLY* in solving his fascinating Stomachion puzzle game, it is quite certain that he would open his eyes in astonishment.

In our November issue, you will recall, we described this puzzle, invented by the famous Greek mathematician twenty centuries ago and lately discovered on an ancient parchment. The game seemed to hold such interesting possibilities that we offered cash prizes to those of our readers who could create the most lifelike animal figures by arrangement of the fourteen geometric pieces contained in the puzzle.

The results, some of which are reproduced on these pages, were beyond all expectations. The winners in the contest, whose names are announced here, as well as the hundreds of other contestants, proved by their entries that the Stomachion of Archimedes is unsurpassed as a test of ingenuity and originality, as well as an entertaining pastime.

FOR this reason, we are offering this month another contest similar in character, with a new set of cash prizes. The list of these prizes, together with the rules of the contest, appear on the opposite page. You will see that the new contest is similar to the preceding one, with a single exception.

This time, instead of animal figures, the competition calls for human figures. The prizes will be awarded to those readers who submit the best original designs of human figures made from the fourteen pieces of the Stomachion.

For the benefit of readers who have not yet made the acquaintance of the Stomachion, a diagram showing its construction is presented here. The game consists of fourteen small pieces of flat cardboard or wood which you cut into specified geometric shapes. Most of them are triangles. When fitted together as in the diagram they form a perfect rectangle, exactly twice as long as it is wide. To play the game, you simply rearrange the fourteen pieces as best you can to form a recog-

These Readers Designed Prize-Winning Animals

Following is the list of prize winners who submitted the best figures of animals in our November Stomachion Contest:

FIRST PRIZE—\$25

F. A. Van Wormer, Yamhill, Ore.

SECOND PRIZE—\$15

Ted Davis, Fresno, Calif.

THIRD PRIZE—\$10

Frank G. Davis, Springfield, O.

FIVE \$5 PRIZES

Frank Logan, South Bend, Ind.

Daniel O'Connor, Davenport, Iowa

Frank C. Rice, Newport, R. I.

Fred Wilhelm, Buffalo, N. Y.

A. E. Warren, Ada, Ohio

TEN \$2.50 PRIZES

Clarence Beck, West Bend, Wis.

E. V. Bowers, New Ross, Ind.

Dr. R. P. Burke, Montgomery, Ala.

Miss G. V. Diplock, Plainfield, N. J.

Edith Duncan, Alameda, Calif.

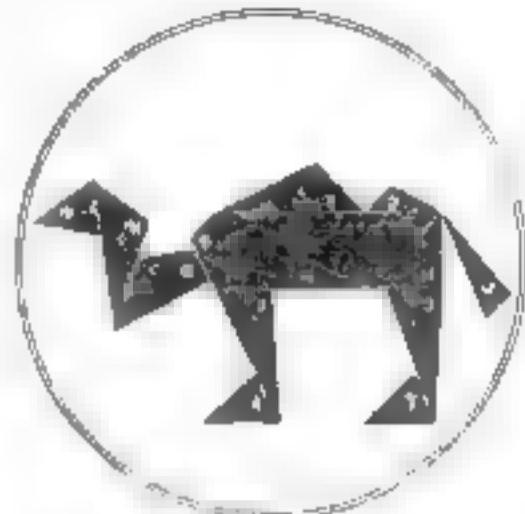
R. P. Frutchey, Paterson, N. J.

Mrs. Auber Miller, Bloomsburg, Pa.

Paul B. Nutum, Milton, W. Va.

S. F. Ryals, Durkee, Ore.

E. E. Sinclair, Wrangell, Alaska



The Camel—Second Prize
Ted Davis, Fresno, Calif.

creation, until the geometric lines and angles, combined, actually seem to live.

To get the spirit of the competition, probably the best way is first to study some of the prize winning animal figures submitted by *POPULAR SCIENCE MONTHLY* readers and reproduced here. What could be a more perfect or lifelike representation of a dog "baying the moon," for example, than the "Howling Dog" which wins the first prize? You can almost hear him howl. Notice how ingeniously the pieces are fitted to mold the body into action.

OR TAKE the second prize winner, "The Camel," and study how hard lines and angles can be blended and softened into the contour of an easy-going beast of the desert. Then, for a swift action and realism that amounts to comedy, look at the flying heels of "The Runaway Mule," the third prize winner. If you find yourself chuckling at this "critter," you may know that you are on the way to becoming a real Stomachion fan.

Such figures as these may appear simple enough, as completed. Actually, though, they represent the solution of brain-twisting problems, as you will soon discover when you try to design a figure yourself. That's what makes the Stomachion such an intriguing puzzle—it name, you know, means "the thing that drives one wild." While it may be simple enough to design a formal figure of a man, for instance, the rub comes when you try to give your figure lifelike proportions and make it express a definite idea or action.

To play the game the first thing to do is to make the fourteen pieces. The simplest way is to cut them from a piece of good quality cardboard, or they can be made from wood, wallboard, or other similar material. To lay out the pieces follow the diagram on page 33. First draw on the board an exact rectangle, just twice as long as it is wide, represented in the diagram by ABCD. Next, mark the middle points of the top and bottom lines of the rectangle, thus fixing the points marked E and F on the diagram.



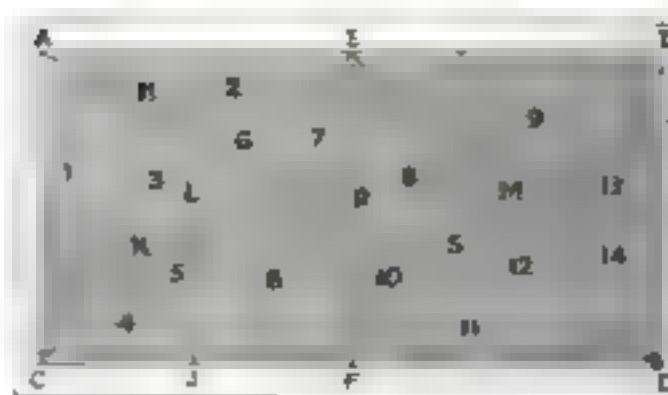
The Runaway Mule—Third Prize
Frank G. Davis, Springfield, O.

Draw the line EF and the diagonals AD, CE, and ED, fixing the point G.

Your rectangle now is divided into two equal squares. Taking first the left-hand square, halve the line AG, thus fixing the point H. Draw the line CH. Then bisect the line CF, fixing the point J. Bisect also the line CG, obtaining the point K, then bisect the line KG, fixing the point L. By drawing the lines JK and JL, connecting these points just determined, you complete the construction of the left-hand square of the rectangle.

TURNING next to the right-hand square, which already is traversed by the two diagonals, ED and AD, bisect the diagonal ED, thus fixing the point M. Draw the line FM. Bisect the vertical line BD, fixing the point N, and then further bisect the line BN, fixing the point P. Drawing the lines MN and MP completes the construction. The points R and S are fixed automatically by the intersection of the lines, and do not take part in the construction.

Now number each of the fourteen pieces as indicated in the diagram. This done, cut out the pieces carefully along the lines you have drawn. Spreading them at random on a table before you, you are ready now to try to fit them together to form your human figure. You are allowed to use the pieces in any position desired, provided you do not alter their form and dimensions. If you wish, you can turn any one of them over on its reverse face. Furthermore, Archimedes' own instructions provide that the pieces need not be exactly in contact with each other, although large gaps between them are considered as actual gaps in the design and taken into account when the



How to Make the Stomachion

On a piece of cardboard or wood, draw a rectangle exactly twice as long as it is wide, then divide the rectangle as shown in this diagram and explained in the accompanying article. Finally cut out the fourteen numbered pieces along the dividing lines

lifelike character of the figure is judged.

At the outset you may find yourself all at sea; the pieces will seem to have a contrary way of refusing to match as you wish them to. But don't be discouraged. With a little practice they will begin to fall naturally into place in your design, and the chances are you will become so engrossed in the problem that you will refuse to leave it until the figure is completed.

In the contest just ended, scores of readers wrote to us telling how they eventually arrived at success out of a seemingly hopeless beginning. The following letter from one of the contestants is typical of their experiences:

"I DECIDED I was going to make a rabbit," he says. "My Stomachion was made from a two-by-four inch rectangle. After several unsuccessful attempts I finally did make something that looked like a rabbit, but it was a terribly proportioned one. After several more attempts, I hit upon the happy combi-

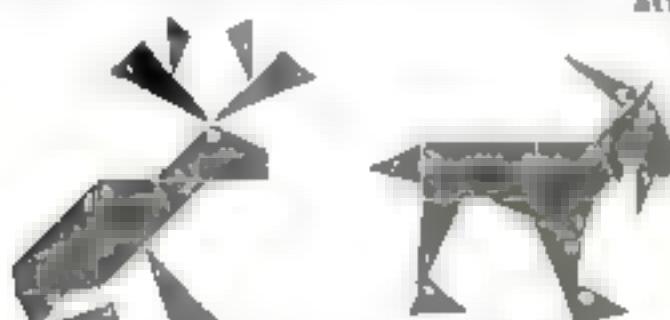
nation. It was by no means an easy task, however, although it proved to be very interesting. Before I had finished my Stomachion rabbit, I had learned much about the correct proportioning of its various parts."

So many excellent figures, worked out in this manner, were submitted in the contest that the judges found it extremely difficult to decide on the winners. Every conceivable kind of animal was attempted, even strange prehistoric monsters. Among them were lizards, apes, ant-eaters, kangaroos, lions, alligators, frogs, rhinoceroses, hippopotamuses, dinosaurs, squirrels, sharks, foxes, elephants, fishes, bears, moths, llamas, deer, skunks, bison, pigs, and so on.

Dogs, cats, horses, rabbits and camels, however, seemed to be most popular. In one instance an entire high school geometry class at West Liberty, O., took part in the contest. Many letters came from men and women who found the game an entertaining form of relaxation.

IN DESIGNING a figure for the contest, the most important rule to remember is that you must use every one of the fourteen pieces. None can be left over. It is this rule which lifts the Stomachion out of the ordinary run of puzzles. For while it is comparatively easy to make a figure using a majority of the pieces, the real thrill comes in including the two or three pieces likely to be left over.

The game is full of surprise, fun, and thrills. Every member of your family and your friends, old and young alike, will enjoy it with you. You will find it not only entertaining, but also valuable in sharpening your wits, training your perception of form and measurement, and stimulating your inventiveness.



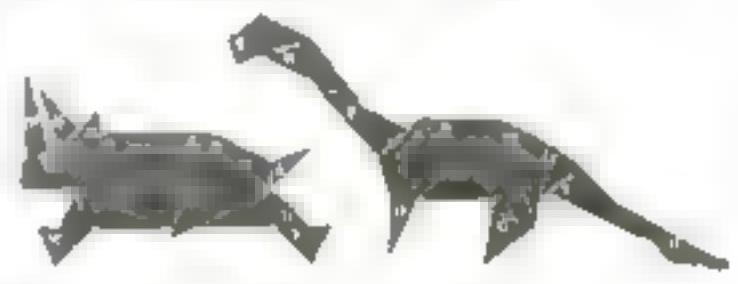
Moose at Rest
Daniel O'Connor, age 14, Davenport, Ia.



The Goat
Fred Wilhelm, Buffalo, N. Y.



The Bulldog
A. E. Warren, Ado, Okla.



Charging Bull Rhino
Frank Logan, South Bend, Ind.
Brontosaurus
Frank C. Rice, Newport, R. I.

Read the Rules of Our New Stomachion Contest

IN PRESENTING a new Stomachion contest this month, POPULAR SCIENCE MONTHLY offers \$100 in cash prizes to those readers who submit the best original designs of human figures made from the fourteen pieces of the Archimedes puzzle game described on these pages. The various prizes are listed herewith.

In a previous contest the game was limited, for purposes of competition, to designs of animal figures. This time it is confined to human figures. One figure constitutes an entry, but any contestant may submit as many separate entries as he desires. In the construction of your figure, all fourteen pieces must be used.

The pieces may be used in any position desired, even turned over on their reverse faces, provided their form and dimen-

THE PRIZES

First Prize	\$25
Second Prize	15
Third Prize	10
Five Prizes, \$5 each	25
Ten Prizes, \$2.50 each	25
Total Prizes	\$100

sions are not altered. Each piece must be numbered according to the numbered diagram given on this page. Decisions of the judges will be based on the originality and lifelike character of the figure, and on neatness and skill in presentation. The sole judges in the contest will be the Board of Editors of POPULAR SCIENCE MONTHLY, and

their decisions will be final. In case of tie, the full amount of the prize will be given to each tying contestant.

You need not buy POPULAR SCIENCE MONTHLY to compete. You can borrow a copy from a friend or examine one at any office of POPULAR SCIENCE MONTHLY or at public libraries.

All entries must be mailed or delivered not later than February 28 to the Puzzle Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.

NEXT MONTH—ANOTHER CONTEST IN THIS FASCINATING SERIES

Nine Chances to One You Don't Know

By PETER
VISCHER



Do This Every Morning In Your Own Home

Arthur A. McGovern, one of the foremost experts on physical exercise in the United States, gives on these pages the exercises he recommends to develop correct breathing habits and posture. He is shown here teaching one of them to a pupil. This is Exercise 6, described in the article, for developing the muscles between the ribs in chest breathing.

NINE people out of ten don't know how to do the first thing they learn in this life, the one thing they practice every single minute of the night and day as long as they live: how to breathe.

Arthur A. McGovern, before whom thousands have passed with broken health and shattered spirit, will tell you that most of us don't know how to breathe, how to walk, stand or sit properly, how to exercise. Most of us, he says, don't know how to do the few simple little things that bring strength and glowing health, color to the cheeks, light to the eye.

Why? Because people are lazy and careless and reckless.

"People generally," says McGovern, "refuse to take any more breath than they have to. All about them is fine, clean, fresh air vital to life and happiness and all. Yet they take just enough to keep the spark glowing."

"Every baby knows how to breathe. And yet with growth and experience, intelligent men and women allow their bodies to become lazy, almost inert. They permit their chests to grow narrow. They sit and lie in postures that hinder the lungs from expanding for their full share of that least expensive of all virtues, fresh air."

"Lots of people exercise, I know it. But many of them do more harm than good. They arise in the morning and go through a few minutes of violent bending and dipping. Others crowd a whole week's exercise into Saturday and Sunday, actually injuring themselves in doing so."

THESE statements are drawn from a deep well of first-hand experience. For while McGovern came from a family of athletes and started his career as a boxer, it took

the realities of the war to reveal to him the mistakes people make trying to keep well.

"I worked in hospitals and with doctors," he told me. "I learned that there is an inner man which is more vital than the outer man. Many of the exercises I had used for training in my boxing days I found to be actually injurious. I had to revise my ideas about exercise entirely."

Later, as a director of clinics, McGovern was further impressed by the need-



The Babe Gets In Trim

Babe Ruth reconditions himself completely at the beginning of a season by correct breathing and exercising. He is especially benefited by this breathing exercise (Exercise 4, in the article) hubbering and raising the upper chest and expanding the upper part of the lungs

How to BREATHE

And most of us don't stand or sit properly—Exercises to increase your daily efficiency

less suffering which comes through ignorance or neglect of proper exercise. As a consequence, he established in New York City a gymnasium of his own, where he put into practice what he had learned. To it hundreds of men have come, some with broken nerves; others with bodies wrenched by the wear and tear of unbalanced living; and by consistent, scientific exercise, they have found new life and vigor.

THREE was S. L. Rothafel—"Roxy," as he is known to radio fans the country over. "Pretty well shot," was the way he described himself when he first entered the gym. Too busy bringing entertainment to others, one day he woke up to the fact that the machinery of his body was running askew. Consistently, he set about to restore it, practicing correct breathing and a few exercises. Today he tells his friends that he is "a new man."

In more than one instance the gymnasium has stepped in where doctors and operations have failed. Sometimes a physician encounters a particularly obstinate case—a man, say, who is narrow-chested, "chicken breasted," with his lungs pushing against his diaphragm, crowding his intestines and his stomach. Such a man was a Wall Street executive, fifty years old, who, although six feet tall, never weighed more than 140 pounds. His physician sent him to McGovern.

"That man was literally starving to death for air," McGovern told me. "He was operated on for intestinal troubles, when all he needed was air. Once he learned how to breathe properly, his lung capacity was increased and his stomach and intestines were raised to normal positions. By the exercising, his chest expansion grew in three months from less than two inches to more than five. His weight advanced to 154 and in a year he'll weigh forty pounds more."

THIS was no miracle. The man just wasn't getting air, and without air he couldn't live. He now gets more oxygen in three hours than he used to get in a day."

McGovern told me that even afflictions as serious as curvature of the spine may yield to right breathing and exercise. Some time ago a young girl of seventeen came to him,

suffering from this malady. She weighed only ninety-seven pounds and her chest expansion was just one half inch. She learned to breathe correctly. In two months she gained twelve pounds in weight and her chest expansion increased to four inches. The curvature disappeared.

"The progress of that girl was extraordinary," said McGovern. "By learning how to breathe in the daytime she unconsciously breathed properly at night. The basis of her trouble was that she was hungry for oxygen."

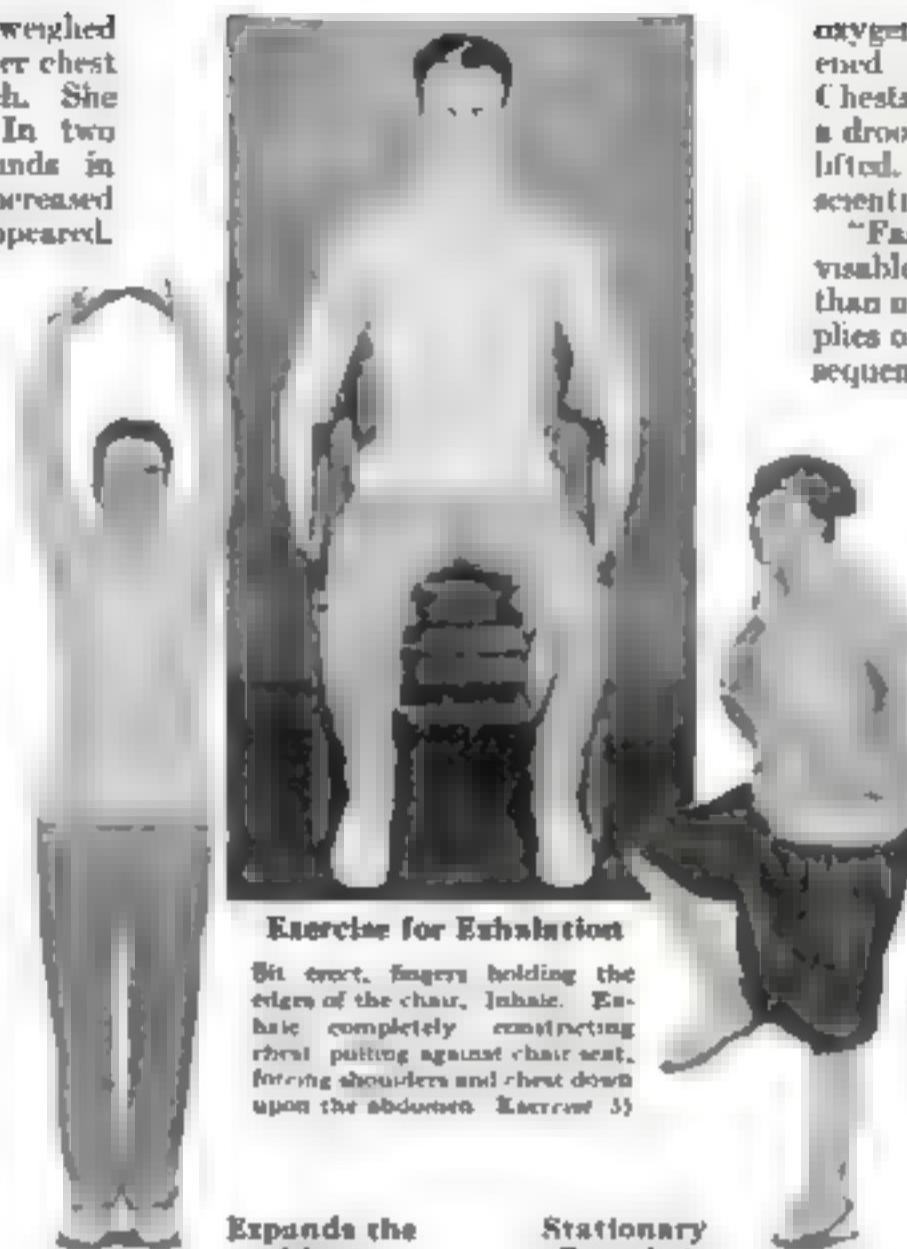
YOU might think that at least professional athletes would appreciate the value of proper breathing. Yet there was Johnnie Farrell, one of the finest of America's professional golfers, whose chest expansion, when he appealed to McGovern, was virtually zero. Farrell spent most of his time in the fresh air, yet derived no benefit from it simply because he didn't know how to use his breathing muscles. In a short time his chest expansion was raised to four inches, his general health improved and his golf game with it.

Another athlete, a professional wrestler of some prominence, possessor of a superb figure and great strength, tried to enlist in the war and was rejected for the most unexpected of reasons: he had no chest expansion. It developed that while he had trained with all kinds of slow physical efforts, he had so neglected breathing that the important muscles across his chest had become tied up. In two weeks, by consistent practice, he increased his chest expansion from nothing to three and one half inches.

Babe Ruth, the great baseball player, likewise reconditioned himself completely at the beginning of the last season by correct breathing, eating, sleeping and exercising. He was subject every hour of the day to expert guidance, and as a result he had one of the greatest seasons of his spectacular career.

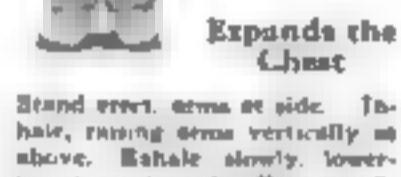
IT MIGHT appear from these and other instances I might relate that a few more breaths are a panacea for all ill. McGovern, however, will quickly dispel any such idea. In fact, he says breathing, like exercise, can be more harmful than helpful. In the matter of breathing, as in other matters that vitally affect human lives, people who are not qualified to do so often are lavish in giving advice. "Take deep breaths," they say. But over-breathing can result in faintness, dizziness and mental confusion. Sudden deep breaths may bring about a morbid and dangerous condition. Intelligent breathing, McGovern tells me, is often worse than no special practice or method at all. And that goes for exercise as well.

"The first rule in breathing," he says, "is to breathe through the



Exercise for Exhalation

Sit erect, fingers holding the edges of the chair. Inhale. Exhale completely constricting chest pulling against chair seat, forcing shoulders and chest down upon the abdomen. (Exercise 3)



Expands the Chest

Stand erect, arms at side. Inhale, raising arms vertically at above. Exhale slowly, lowering arms to side. (Exercise 2)



Stationary Running

Bring knees high, holding shoulders high running in one spot. This stimulates lungs, heart and red blood cells. (Exercise 1)

nose and not the mouth. The passages of the nose are protected to catch countless germs and particles of dust contained in every lungful of air. Mouth breathing allows these harmful particles to pass into the bronchial tubes and lungs. Keep the nasal passages open always. Growths, chronic catarrhal infections or head aches should receive the prompt attention of a nose specialist.

"Poor ventilation and obstructed nasal passages are important causes of ill health. And yet I have found that a shortage of

IT MIGHT appear from these and other instances I might relate that a few more breaths are a panacea for all ill. McGovern, however, will quickly dispel any such idea. In fact, he says breathing, like exercise, can be more harmful than helpful. In the matter of breathing, as in other matters that vitally affect human lives, people who are not qualified to do so often are lavish in giving advice. "Take deep breaths," they say. But over-breathing can result in faintness, dizziness and mental confusion. Sudden deep breaths may bring about a morbid and dangerous condition. Intelligent breathing, McGovern tells me, is often worse than no special practice or method at all. And that goes for exercise as well.

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oxygen is more likely to come from weakened and relaxed breathing muscles. Chests that have been allowed to settle in a drooped, cramped, rigid cast should be lifted. For this games and exercises, scientifically applied, are valuable.

"Fast or forced breathing is not advisable, nor is holding the breath longer than normal. These result in excess supplies of oxygen to the blood, with a subsequent lessening of carbon dioxide. Normal breathing must be habitually regular, and this can be made possible by two rules.

FIRST, in deep breathing, breathe slowly to use the full lung capacity without getting too much oxygen in the blood. If a breath is twice as deep as usual, it should be twice as slow, or else be taken half as often. Second, engage in some movement while breathing deeply, since active muscles use up more oxygen than do passive. At the slightest drowsiness discontinue the deep breaths and turn at once to more active exercise.

"Finally, hold the chest well up and rounded, though not exaggeratedly so. This makes the work of the heart easier and allows the blood greater freedom in taking oxygen from the lungs."

Here are half a dozen of McGovern's simplest and most effective exercises:

Exercise 1. Stationary running. Bring the knees high, with hands on hips to relieve the chest of their constricting weight, shoulders held erect, chest freely but not extremely expanded. Breathe fairly slowly, quite deeply but not forced. Continue for two minutes.

This exercise stimulates the lungs, the heart, and the red blood cells which carry oxygen. It brings about a more complete delivery of oxygen to the cells and of carbon dioxide to the lungs.

Exercise 2. Take erect position, arms at side. Inhale slowly, raising arms until they are vertical at completion of inhalation. Begin immediately to exhale and lower the arms. Take this exercise very slowly to prevent overbreathing. Repeat five times.

This exercise is to expand the lungs and raise the ribs to their limit of flexibility.

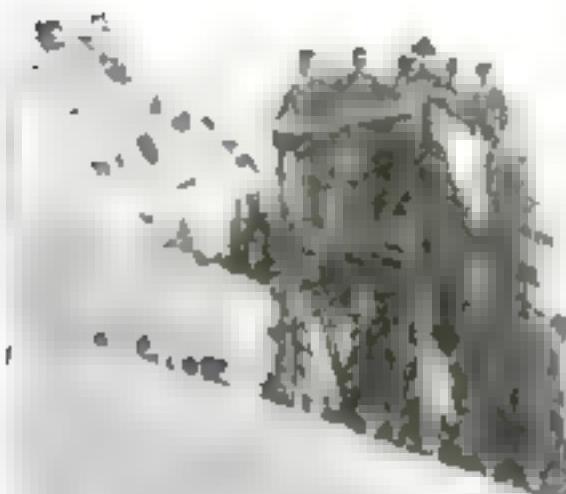
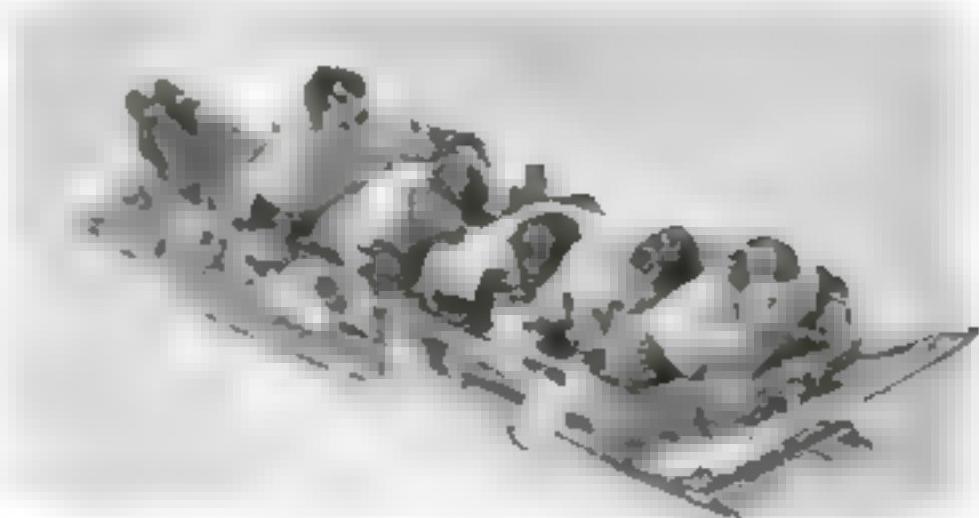
EXERCISE 3. Sit erect in an ordinary chair, fingers holding the edges of the seat. Inhale slowly, exhale as completely as possible, constricting the chest forcibly and at the same time pulling against the chair seat and forcing the shoulders and chest downward upon the contents of the abdomen. Repeat this exercise slowly five times.

This exercise insures complete use of the powers of exhalation, which is quite as important as inhalation. (Continued on page 126)



King of Sports for Everyone

Tobogganists know their own thrills—the rush of wind against stinging cheeks, careering down a ribbon of ice between banks of snow at forty, fifty even sixty miles an hour! Right: On the slide at Lake Placid

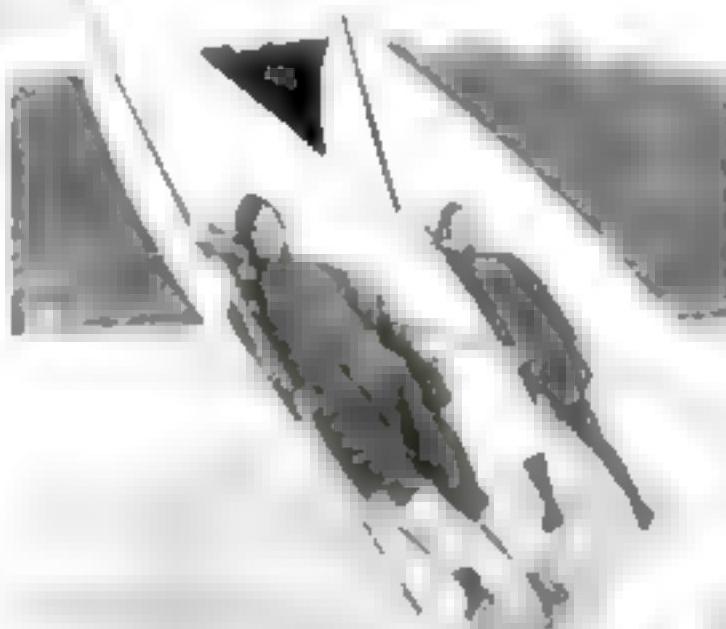


Thrilling Moments

Speed's the Thing in Winter Sports—

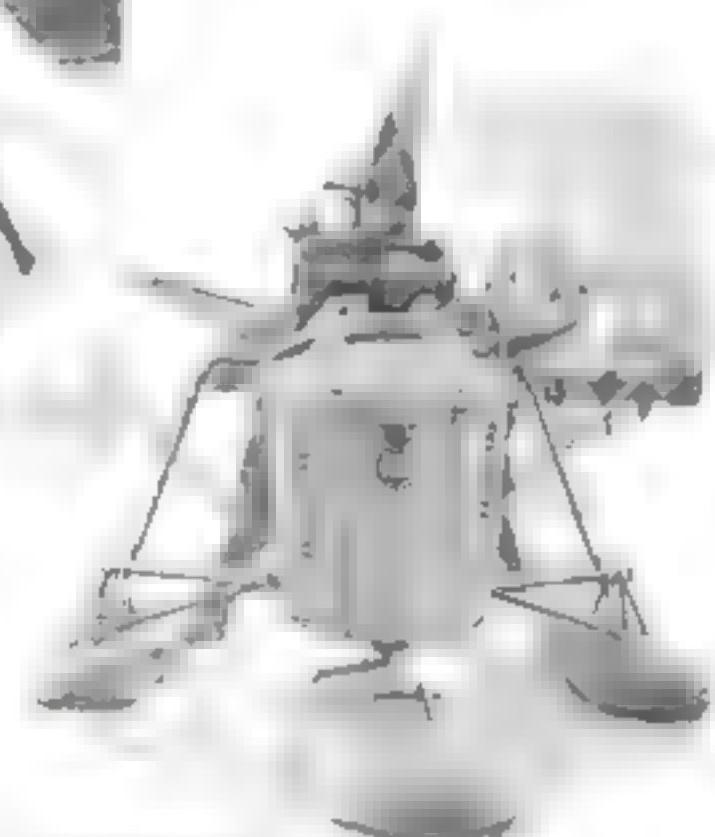
He's Off!

A headlong rush down the run, a leap into space a moment when the universe pauses as you hang in mid air, then the expertly calculated landing: these are the orations the ski master knows. The photo above shows a skier taking off at the top of a run in the Alpine paradise at Wengen, Switzerland.



Human Sailboats

Sharp winds on the ice hold no terrors for skate sailors whose huge canvas wings add a new spin to a favorite sport. Lake Hopatcong, N. J., takes on the appearance of a strange regatta on days when a stiff breeze promises good "sailing."



Aerial Sledding

Russia goes in for aerial sleigh racing for its thrills. Above is shown one of the queer looking sleds at the start of a 400-mile dash over ice and snow from Moscow to Leningrad. It is driven by an air propeller.



Queen of the Ice

In the gay whirl at St. Moritz, world famous winter sports center—Katie Schmidt, well known player with Howard Nichols, in a daring exhibition on the ice.



Where the Horse Still Wins

A trotting race on ice using sleighs left, furnishes an unusual sport for participants and spectators alike at Garmisch, the winter sports mecca of Germany.



Hockey for Men Only

Left: Remarkable action photograph of an exciting moment in an ice hockey match between English and French players at Chamonix, France. Note the spectacular leap of the man at the right.

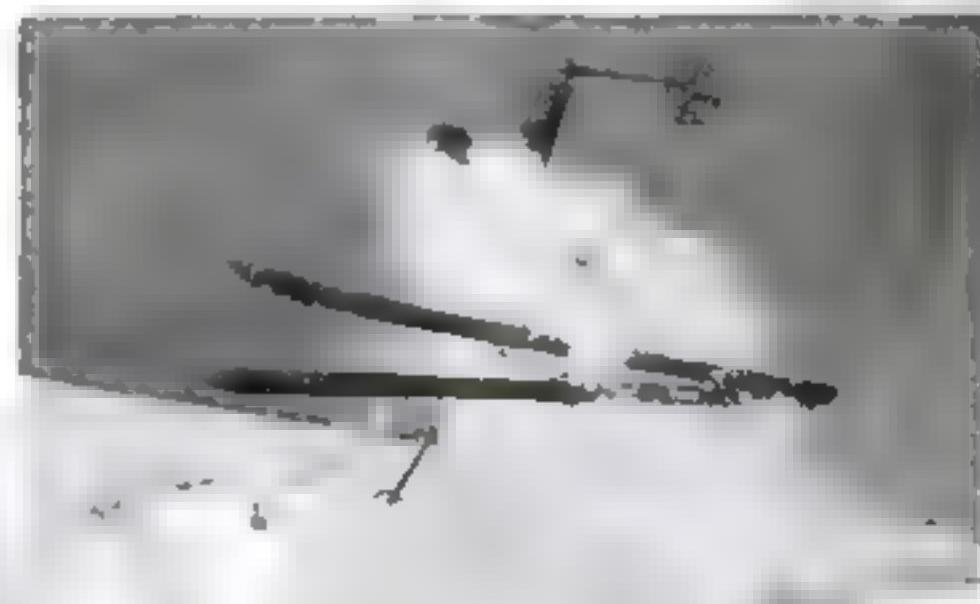
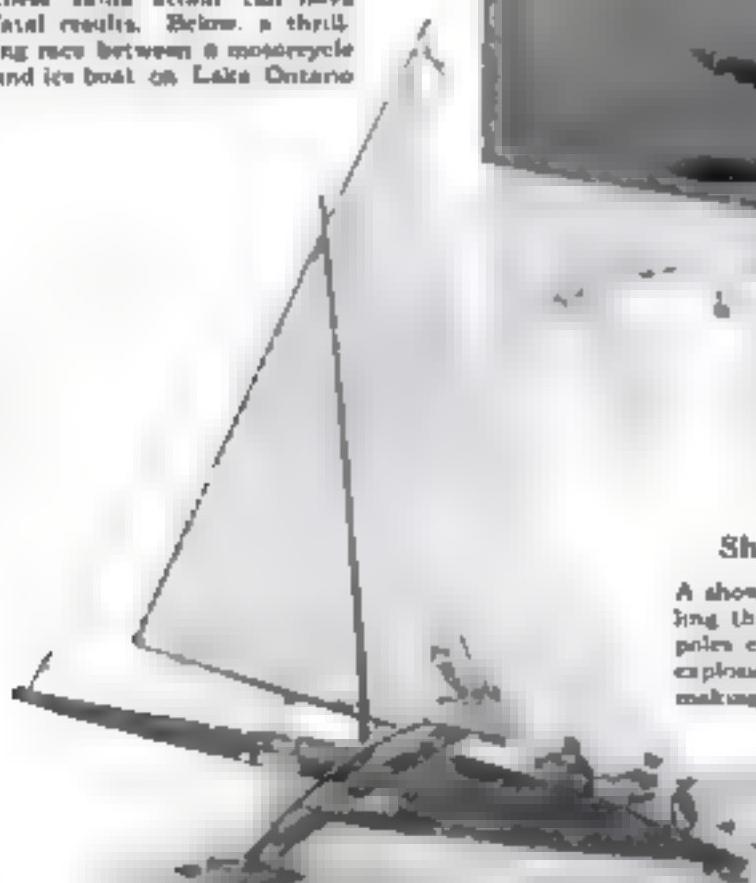


on ICE and SNOW

the More Dangerous the Better!

Racing with Death

Nerves of steel and a cool head must the ice yachtsmen have, for a spill at the top speed these skiffs attain can have fatal results. Below, a thrilling race between a motorcycle and ice boat on Lake Ontario.



Sharp Curve Ahead!

A shower of snow, two skis hurtling through the air, two balance poles emerging from the feathers explosion—it's just a ski jumper making a sudden turn at the Alps.



Two Skis and a Fast Horse

Sliding is a favorite winter sport in Sweden, is fast winning devotions in America. The trick is to cling to the reins of the horse while holding your balance to avoid a tumble. Some even press controls into toe to attain a speed of fifty miles an hour.



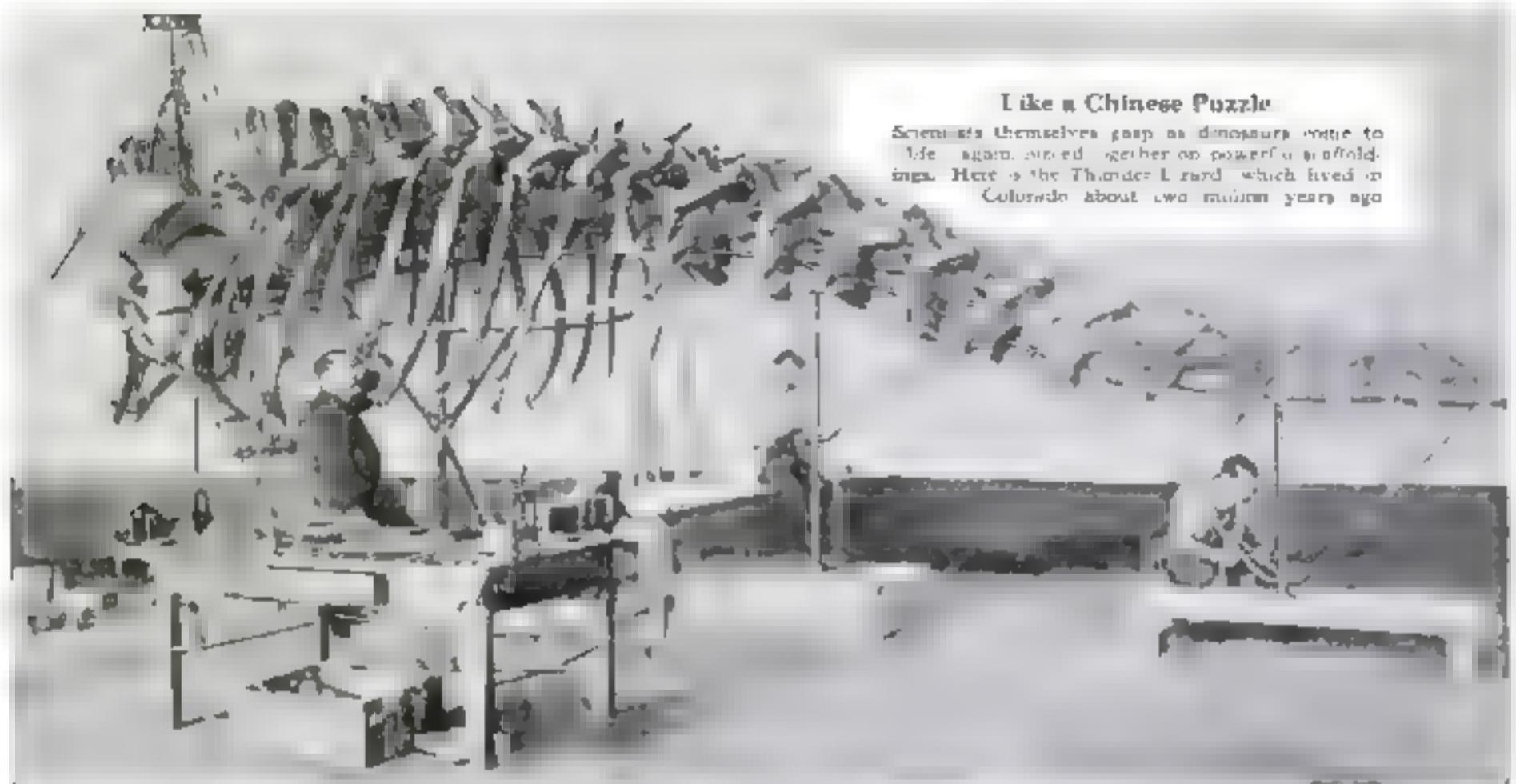
High-Jumping on Ice

No, this isn't a trick photo. In fact, the daring leap Phil Taylor above is performing over Miss Freda Whitaker, also a well-known skater at St. Moritz, Switzerland. Is no everyday job with him.



He Skates on Stilts

Here's a skating stunt you might spend the rest of the winter practicing—and then you'll! Phil Taylor performing breath-taking tricks on novel stilt skates at St. Moritz.



Like a Chinese Puzzle

Scientists themselves gasp as dinosaurs return to life again joined together on powerful scaffoldings. Here is the Thunder Lizard which lived in Colorado about two million years ago.

"But Such Beasts Never *LIVED!*"

Science answers by piecing together bones of prehistoric animals—One tooth can give the clew, and the results are astounding—Some monsters recently restored

By SAMUEL D. FUSON

WITH bodies poised high on colossal hind legs steamed by powerful tails, and with incongruous little fore legs locked in a mighty death grapple, two giant dinosaurs fought it out on the banks of a shady lake. The battle occurred where Montana is now, but a strange, primordial land it was then. The victor contended on his way, while the vanquished one sank into the soft earth and gradually he was covered with fine particles of mud.

There, three million years later, bones were found by another creature that nature, in her mysterious workings, had evolved, man. The frame of the ancient monster was intact except for a few bits the ferocious victor had flung aside. Even the imprint of the feet was found, in the evidence of the death struggle that had occurred ages before man came into being.

Carefully the bones were dug up, packed in enormous crates and forwarded to the workshop of a great museum. Expert workers, supervised by paleontologists, spent months matching the parts, and there emerged finally the restored skeleton of a giant Tyrannosaurus, the largest terrestrial flesh-eater of all ages. A photograph of this prehistoric

monster is found on the opposite page.

None of the curious creatures that swam, crawled, stalked or flew when the world was young has ever been seen by man. They roamed the earth and passed to extinction thousands of years before we came along. Not even a rude rock sketch has come down to us, for there were no men to write them.

Yet we know what a dinosaur looked

like; our museums are filled with complete models or pictures of some 15,000 of the earth's earliest inhabitants. Much as we are tempted to exclaim, standing in the shadow of those huge ranks, that such grotesque monsters simply couldn't have existed, scientists assure us that we are gazing upon creatures exactly as they roamed the forests infinite ages ago.

How can they know? What is the explanation?

I used to find the answer. I went to one of the world's largest museums and their leading paleontologists. I spent hours in their workshops, where large and small bones, either whole or in fragments, are matched carefully as some strange monster is reconstructed. And I found that science is guided in this interesting process, much as it is in other branches, by known facts, aided and abetted by the law of probabilities and scientific guesswork, guesswork that is founded on a thorough knowledge of anatomy and of living animals.

My inquiries quickly exploded the popular idea that an entire unknown animal may be restored from a single great bone. What is true is that the size of a creature can be estimated from a single bone or a great tooth,



The Evidence Written in Rocks

But for the fact that skeletons of ancient monsters became imbedded in solid rock thousands of years ago, we should have no hint that they even existed. Above: chasing away the skull of a prehistoric rhinoceros, found in Oregon.

and that, in the light of present-day knowledge, the paleontologist can identify a given bone as belonging to a particular animal.

Thus, if only a few bones are found, the whole animal can now be reconstructed on a basis of known facts about other animals of the same species.

For example, when the great reptile Triceratops was pieced together from a goodly assortment of bones, most of the skull, with its formidable looking horns, had been found, but the nose was missing. Other incomplete skeletons supplied the knowledge that the nose, too, was armed with a knob and that the skull ended in a beak. Triceratops received a beak on his lower jaw, also, on the theory that nature probably had matched here the knob on the skull.

A SINGLE blunt round claw suggested that Triceratops had subsisted on herbs and therefore that the sole of his foot was a soft pad. A few vertebrae and half a barrelful of fragments gave the length of his back and tail. So the picture was completed, and Triceratops reared his queer, beaked head again after countless ages of sleep.

Dinosaurs, those "terrible lizards" so often on the front pages of newspapers, have only lately been reconstructed with anything approaching scientific accuracy. Museum workers scarcely believed their eyes as, perched on high scaffolding, they pieced the creatures together; monsters so great and so uncouth as to defy any other description than the word dragon.

Some of them resemble the modern crocodile, while others display characteristics of the ostrich family. No land animal today approaches them in size. The finding in the last few years

of almost complete skeletons in western United States and Canada has enabled us to reconstruct numerous varieties of them.

Brontosaurus, the Thunder Lizard, was perhaps the biggest brute that ever walked the earth. As pieced together, he was a creature forty to seventy feet long, having a small head, short body with a decided fat man's paunch, long neck and an even longer tail. Apparently he had no defensive or offensive weapon except his size, and he probably took to flight in the water when attacked by some of the contemporary flesh-eating dinosaurs. Triceratops, the three-horned animal mentioned above, was perhaps the strangest looking of the dinosaur tribe. His skull was built like a fireman's helmet or a woman's sunbonnet extending backward over the neck.

BUT it remained for an American to effect the restoration of the mightiest of all dinosaurs, King of the Tyrant Reptiles and largest flesh-eater of all ages: Tyrannosaurus, participant in the titanic death struggle described at the opening of this article. As restored by Barnum Brown, who discovered the fossil remains, this beast towers twenty-two feet high and has a length of forty-seven feet. His hind legs are formed like those of birds, and the bones are hollow. He was a powerful creature, swift of movement and capable of destroying any of the contemporary critters, a king of the period and monarch of his race.

Brain power wasn't a strong point of these ancient monarchs of the earth, the restorers have learned.

Despite their great size, they apparently knew only just about enough to eat when they were



A Battle 3,000,000 Years Ago

Rocky imprints of dinosaur feet found in western United States have enabled us to trace the progress of one of their titanic struggles. Here is their fighting pose at the commencement of a battle, as reconstructed by the American Museum of Natural History.

hungry. Trachodon, thirty-five feet long and sixteen feet high, had a brain cavity barely the size of a man's fist. Brontosaurus possessed a brain weighing only two pounds. They weren't bothered with dental troubles, either; as fast as one tooth wore out, another replaced it. Trachodon had a reserve supply in his four jaws of 2,000 teeth!

Mammoths and Mastodons, unlike the Dinosaurs, lived contemporaneously with early man, and occasionally an artistic individual scratched an outline of one of them on a rock. Almost complete specimens of the Mammoth have been found preserved in the ice of Siberia and Alaska. Their reconstruction, therefore, is now comparatively easy.

THIS has not always been so, however. Albert Koch once restored a Mastodon by using in their places bones that did not belong to the giant and placing the curved tusks so that they stood out at right angles to the sides of the head! An early restoration of the great Dinothereum, a relative of the Mastodon, showed the beast lying down, because it was unknown what kind of feet he had, or, in fact, whether he had any feet at all.

How do we know, you may ask, whether an extinct monster was covered with hair, feathers, or scales, when only the bones remain? The answer is that occasion-

(Continued on page 149)



Peering under the Earth's Crust

Strange forces seen working mighty changes in our solid globe - Boyhood of a modern magician of science - The romance of whaling - Other new books

By THOMAS M. JOHNSON

"Our Mobile Earth"

By Reginald Aldworth Daly. Scribner \$.

WHERE we live may in some degree decide the chances of our experiencing an earthquake in our lifetimes. Professor Daly's book explains, for one thing, why the greater part of the United States has little to fear from this danger.

Strains caused by the buckling of the earth's young, high and rugged mountains are the real cause of earthquakes. The two great earthquake belts virtually follow the course of the mountains. One belt is along the border of the Pacific Ocean basin. The other follows the seas from the East Indies through the Himalayas in Asia, the Alps and Pyrenees in Europe, to the West Indies and Central America. Most of the great earthquakes of history, including the San Francisco and Japanese disasters, have occurred in these belts. The first includes the Rocky mountains and passes just south of Florida. Otherwise the United States escapes.

The answer to many other amazing things upon the surface of the earth, it seems, is to be found inside it. Before we go very far down, we come to molten glass. The continents are actually a crust floating over this glassy sea. If we could get through the glass, we should finally find ourselves in the "lower regions," which scientists agree are really as hot as Tophet. Here temperature can be measured only in thousands of degrees—it is probably 6,000 degrees hotter than the surface of the sun. In the very center is a core of probably iron all red with nickel and other metals, having a density one and one-half times that of iron at zero pressure.

The relief of elastic strain in the solid body of the earth especially the crust, causes tectonic earthquakes, which do the most damage. The crust is always subject to forces of electricity like those of a wound-up steel spring. When the spring snaps, the earth shakes.

Yet the toll in human life of tectonic earthquakes we learn, does not equal that of the galomolak, or the death rate from volcano earthquakes is no greater than the murder rate in a city.

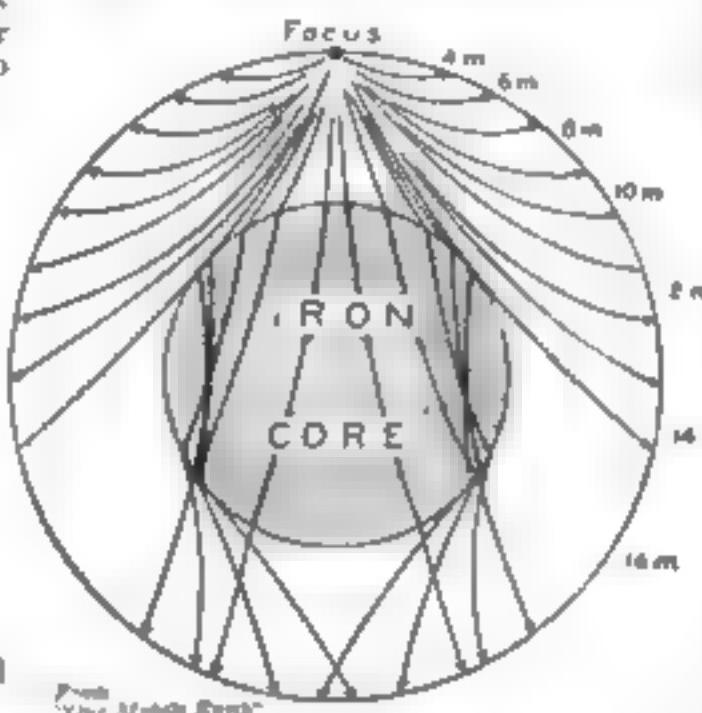
"A Magician of Science"

By John Eliot Hopwood. Century.

THE first scientific experiment of the great Charles P. Steinmetz was a failure. He built a tower of wooden blocks, and to illuminate it placed inside it a lighted candle. The candle set the blocks afire and nearly burned the house down. But as the young inventor was

only five years old, his first experiment did not ruin his career.

In fact, points out the author of "A Magician of Science," the entire boyhood of Steinmetz reminds us that as a child a natural bent is developed with



How Earthquake Tremors Travel

Cross section of the earth showing paths of earthquake waves, and the time, in minutes, it takes them to be felt at distant points

intelligent guidance, so will the man develop. From the blocks, the boy graduated to a toy locomotive. At eight years he amazed his instructors in mathematics. At fourteen he was making his own scientific investigations.

The turn of mind that caused the boy to build lighthouses led the man to make 200 inventions. One of his last achievements, before his death in 1923, was a machine that produced a lightning bolt having a million horsepower. The builder of toy blocks had become a forger of thunderbolts.

"Father's Gone A-Whaling"

By Alice Fushing Gardner and Nancy Cabot Osborne. Doubleday Page

"Whaling North and South"

By F. V. Morley and J. S. Hodgeson. Century Co.

WHALING is a romantic but ugly calling, judging from the vivid pictures drawn in these two books. Here is how the monsters of the sea are carved up and their treasure of oil taken out by the bucketful, as described in "Father's Gone A-Whaling."

The whale is fastened to the ship by a chain and two lines, its huge weight banging and shaking up the ship at every roll of the sea. A wobbly plank staging is rigged above the monster. From this the whale's head is cut off, and then the

blubber, which comes off in big strips called blanket pieces. These are hoisted over the side and dropped into the hold by a windlass.

"There's a nice oily place for you," we read. Four of the crew work like beavers cutting up the blanket pieces into horse pieces that are small enough to go into the big kettles of the try-works. Every time the ship rolls, down they fall onto the blubber swimming with oil.

Everything is going full blast: three four men on the cutting stage, cutting the big strips of blubber, and the sharks snapping at 'round them for a little snack o' whale men at the windlass turning for dear life to haul up the big blanket pieces men in the hold cutting the blubber, the rest leading the fires under the great pots of the try-works and throwing in horse pieces to be tried out. The decks are running with oil, and everybody is soaked in it.

"By and by the blanket piece is hove inboard and the carcass of the whale is let go. It floats aft in a regular smother of sharks, each one hungrier than the last. We all turn to, hard's we know how, to finish off the head.

"In the head of a sperm whale is a regular tank, called the case, full of the very sweetest and purest oil, the captain has to open this up with his spade and then bail it out with a bucket."

"Concerning the Nature of Things"

By H. D. Bragg. Harper.

"The Story of the Atom"

By F. E. Sherwood. Greenberg.

Elementary Principles of Chemistry
Edited by Raymond B. Shaw, Wm. J. Hornbeck, Robert H. Foster, Michael D. Sabin, and Jose E. Ulibarri. Long & Bioren.

CHEMISTS, asked today, "What is the most important and fascinating investigation in which science is now engaged?" would very probably reply with one voice: "the search to release the energy of atoms."

Not in the same breath they would say, "Who knows whether, when it is done, the results will be good or evil? To release atomic energy may be to add untold riches to the world—or to bring upon it catastrophic destruction."

In these three books is told enough of the story of the newest discoveries of science to show their infinite possibilities. Chemists and physicists are far from offering definite conclusions, but already the new theory has been stated that matter is nothing but electricity. That is the electron theory of the atom, holding that the atoms of all elements are made up of positive and negative electricity and nothing else.

(Continued on page 188)



What a wind twister did to a non-stormproof frame house on Long Island, N.Y. Walls were demolished and furniture swept out. Other similar houses, on the same street, built with anti-storm features, were unharmed.

Could a Gale Wreck Your House?

How to Fortify Your Foundation, Walls, Windows, Porches and Chimney against the Havoc of Storms

"THE hurricane cut my house in two like with a razor!"

A man made the statement somewhat boastfully to a group of spectators standing before the wreckage of his frame dwelling in Miami shortly after last fall's catastrophe. Obviously the owner was somewhat proud of the neat job done on his house by the big storm compared with the mauling and mangling of other residences.

"I tell you we were lucky gentlemen," he continued, "that our family was all downstairs when the top half of the house blew away."

"You were lucky all right," agreed several spectators.

"Yes, sir, we were. Because that top half sailed right into the Atlantic Ocean and I guess it's now traveling with the Gulf Stream to Europe. It's a good thing, too, that the furniture went with the second story instead of falling on our heads. A hurricane is mighty freakish, gentlemen. Here is my house cut in two and right across the street you see another house of the same size, style and everything that is hardly touched—only windows gone."

"Perhaps a hurricane is freakish," spoke up a bystander, a cobbler, "but I see

By JOHN R. McMAHON



Anchoring a Frame House

A sill of the usual type should be tied to the foundation with three fourth inch bolts imbedded eighteen inches in concrete or masonry. Attach the floor joists with iron U-straps

your house was put up with short studs."

What's that got to do with it? demanded the householder. "We put a good two by four plate on the first story studs and nailed down the second story studs on that in good style."

"Yet there was a horizontal seam," insisted the builder, "that was just prime for the hurricane to rip apart. There was not even sheathing to reinforce the seam. Nothing but a half-inch siding board and some building paper to let go, plus nails at the foot of the studs that the carpenter was careless about. I happen to know that the house like yours across the street, which is still standing, has full length studs from foundations to roof, and is diagonally sheathed besides."

That little episode offered an excellent demonstration of the value of good construction as a protection against hurricanes, cyclones, earthquakes, explosions and other catastrophes generally called "acts of Providence." Another one that comes to my mind happened out in Kan-

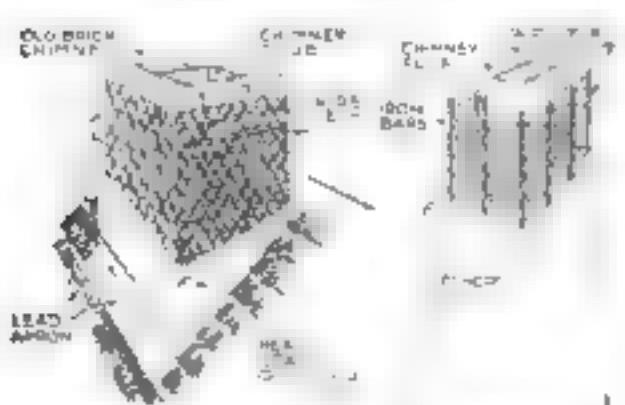
sas when a farmer was driving some visitors in his car along a highway that had been in the swath of a recent cyclone.

"A cyclone is mighty freakish, boys," declared the farmer. "It runs along for miles, making a clean pick-up of everything in its path, houses, barns, haystacks and automobiles. Then it gets kind of playful and hops, skips and jumps like a hurdle race at the county fair. See how it leveled everything here but skipped that house there and a barn yonder."

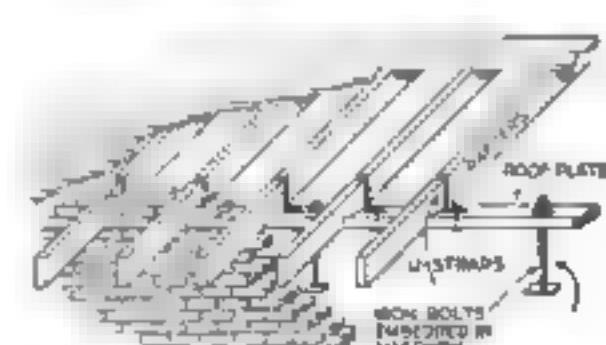
"THAT'S interesting if true," remarked one of the passengers. "I mean if the cyclone does the acrobatic act. How about the explanation that there is a difference in the strength of buildings? Suppose that the cyclone cuts out the poor houses and leaves the good ones?"

Similar statements about the "freakishness" of explosions were published following the detonation of a few million pounds of T.N.T. at the Government arsenal at Lake Denmark, N.J., last summer. Some near-by houses were spared and some fairly distant ones were wrecked. I felt the series of shocks twenty miles away, where I live, and later had a close-up of bursting shells and of a devastated area that resembled the western front in the world war.

The occasional frolic of an earthquake



An old brick chimney may be fortified against wind by surrounding it with wire mesh and coating with stucco. Earthquake regions require the protection of concrete and iron rods.



Roof plates anchored to the rest of the structure with bolts in this fashion won't likely be waltzed away by the first blast of a frantic gale.

along the Pacific Coast is usually described as eccentric in effect. Supposedly, it picks and chooses its architectural victims without reason, leveling an ancient mission and a brand-new structure with the same malevolent tremor. Many persons apparently believe that the best protection against "acts of providence" is a rabbit's foot in the pocket and a horseshoe suspended over the front door.

THET fact is that practically all of the disasters cited are as preventable in their major effects as smallpox and typhoid fever. Houses easily can be built proof against hurricane, cyclone and tornado, reasonably safe against earthquake, and quite secure against explosion. The expense is not great, little if any more than that for first class, sound construction. And a building that is proof against the elements is also fire safe, comfortably cool in the summer and easy to keep warm in winter. It costs little for upkeep and also endures longer.

Some day "disasters" will be regarded as national scandals, on a par with bootleg milk, contaminated water supply and outbreaks of yellow fever. There will be no doubt that the wind blew hard, the area was flooded and so on. The danger possibilities of all sections of the country are well known today and may be guarded against.

"Why, the wind blew 130 miles an hour in Florida," exclaimed a friend, discussing the matter with a New York architect.

"I doubt it," replied the architect. "The anemometer generally quits before that speed. However, if true, man creates a gale almost twice stronger than that and travels in it in a machine of less strength than a well-built house. The airplane, of course. It makes and buckles its own hurricane."

"But look how that steel office building in Miami was twisted and ruined."

"IT WAS the only one of its kind seriously damaged. Its base was very narrow. All the other large buildings and the well-built houses came through safely."

"Did you see how a man was trapped in his hotel room because he couldn't open the door against wind pressure?"

"That was some pressure," agreed the architect. "At 100 miles an hour, it was more than forty-nine pounds a square foot. Like the weight of a piano on a medium door. On a large door, about half a



Points to Avoid

Here's a type of house not to build if you live in a region of strong winds. High-pitched roof, projecting porches, bay windows, dormers and gables, all invite destruction by impulsive gales

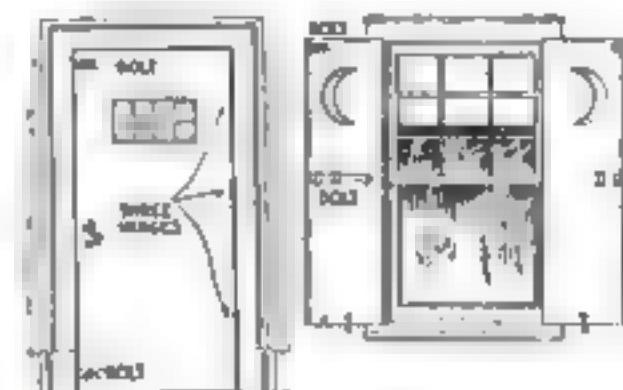
ton of pressure. I would not advise big windows for a hurricane or cyclone region."

Good masonry of brick, tile, stone and concrete block twelve inches thick will withstand everything except earthquake or near-by explosion. Reinforced concrete will resist a quake. That some concrete block structures collapsed in Florida only proves inferior design, poor materials and workmanship. It was shown at Lake Denmark that plain but substantial masonry may resist the shock of a great detonation. Few cracks were visible in masonry throughout the neighborhood. More clumsy stood than fell. In the heart of the arsenal's devastated area remained a large stone house, seemingly unscathed by the gigantic demoniac forces that had raged about it. Stanch walls deserve the credit.

The massive nature of a masonry dwelling tends to make it self-anchoring against wind pressure. Its weakness may consist in a wooden roof not well attached to the outer walls, and in defects of the interior wood structure. If floors and interior walls are wood, they should be substantial approaching the rigidity of the outside material. The roof plate should be anchored to the outer wall every three feet with iron bolts deeply embedded in the masonry, and each rafter end attached to the plate either

with U-straps or with heavy angle irons and lag screws.

However, a roof plate may well be dispensed with, rafter ends directly U-strapped with embedded bolts and the spaces between rafters filled solid with masonry. The latter detail is excellent for air-tightness and fire safety, while it adds strength. The roof may be also anchored to the internal structure of the house by connecting rafters to attic floor beams, whether with iron rods or with boards securely nailed. A little internal trussing or bracing will tie the roof so well to the house that it will resist the utmost persistence of tornadoes and suchlike to go astray.



Door and Window Safeguards

Build your doors of heavy lumber, stoutly hinged and bolted, and you won't have to brace them with the piano when a hurricane rages. Windows should be shuttered as above, and small-paned, to lessen the chance of breakage.

"Can a frame house be hurricane-proof?" asks a reader in Texas, where the big winds sometimes prevail.

IT CERTAINLY can. Wood has more strength than it is usually credited with. Its direct failure under stress is rare compared with separations due to poor joining. A frame house is not self anchoring, but it can be tied securely to its foundations. Whether there is a cellar or not, it is well to have a complete foundation at least a foot thick, if concrete, or sixteen inches if masonry, and not less than four feet deep. Such depth allows for flooding and undermining, and in the north gives frost protection. Heavy piers could be substituted for a complete foundation, but would cost about as much.

Concrete weighs toward 150 pounds a cubic foot, and the foundation described would give a small house a dead weight anchorage of more than thirty tons. There would be an enormous soil friction, besides, to resist the jolts and jerks of hurricane or cyclone. If the house has the usual sill, this timber should be tied to the foundation at not more than four-foot intervals with three quarter inch bolts embedded eighteen inches or so in concrete or masonry. Of course, heavy washers and nuts should terminate the upper ends of bolts. Floor joists may be attached to the sill with iron U-straps and lag screws. The straps should be placed so as to give room for the studs at the joist ends. Studs spiced to the sill and also



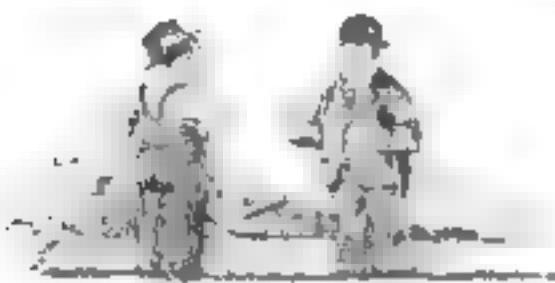
Structural Weakness, Not Providence, Responsible

A New Jersey house passed off its foundation by a severe storm. Modern methods of construction would anchor the frame securely.

(Continued on page 14)

Try These Seven Mental Tests

Sam Loyd Offers New Brain-Twisters to Prove Your Abilities

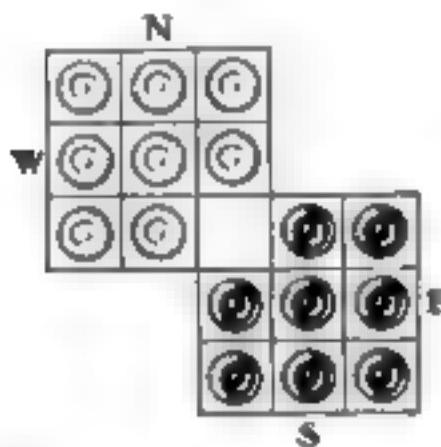


Was He a Good Bargainer?

AFTER quite a parley as to terms, I engaged a laborer to undertake the digging of the cellar of my new cottage. He had wanted \$7 a day, but would not guarantee to work steadily, and as I wanted the job done quickly we compromised on \$8 a day, with a penalty of \$15 for every day he "laid off."

At the end of sixty days the job was completed, but if we had settled on the basis of our agreement, that cellar would not have cost me a single cent. How many days do you figure he worked?

Do this in your head and, if you time yourself, you'll gain a pretty good idea of how you compare with others in mental arithmetic. The correct answer and your rating appear on page 154.



Check Up Your Reasoning Power

HERE'S a test that will tax your patience and skill, but first copy the design above in enlarged form to accommodate standard checkers that you may work with. In the upper section place eight white checkers as shown; in the lower section eight black checkers.

The proposition is to effect a transposition of the two groups—the blacks to be shifted to the northwest and the whites to the eight southeast positions. You can move the checkers from one square to another with the additional privilege of jumping a checker over another to the vacant square. Moves and jumps must always be made north, south, east or west—never diagonal.

Blacks and whites do not have to move alternately, move and jump the sixteen checkers in any order you like as long as the direction is always horizontal or vertical. For the opening, as you see, you may move or jump north, south, east or west. Keep a record of your moves, writing them down in sequence, as, for exam-

ple: move east, jump west, move west, jump east, and so on.

This problem would be quite easy to work out if you allowed yourself an indefinite number of moves, but to make it a real test of your mental agility, can you do it in the minimum number of moves and jumps? The minimum is forty-six shifts. This will take you some time to do, but time yourself and then turn to page 154 for your rating.



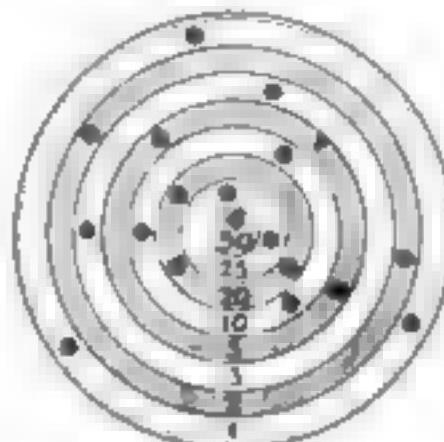
Your Skill at Mathematics

"IT'S no joke about the biggest fish always getting away," remarked an old angler. "The biggest tuna I ever saw 'played' me for three hours and finally made a parting leap over the skiff."

Pressed for data, this mathematical fisherman replied:

"Well, I calculate that the monster's head was two and one half feet long, his body one foot less than the combined lengths of his head and tail, and his tail was one half foot less than one half of the combined lengths of his head and body!"

Can you prove this fish story by calculating mentally what the length of that lost tuna must have been? The time it takes you will be an index of your skill at arithmetical deduction. Your rating will be found on page 154.



One for Mental Sharpshooters

THREE crack shots fired six shots each at the same target, and all eighteen shots reached the target, in the positions shown above. Honors were even, all three being credited with the same total of points.

Can you sort out mentally those eighteen shots into three groups which total alike? See how long it takes you, then turn to page 154 for your rating at mental sharpshooting.

Have You Sharp Eyes?

THIS line of letters was a readable sentence before the letter K, appearing in five places, was eliminated.

I T T Y N I T T E D H A I L T S

Can you make the sentence? As a test, it will show whether your eyes are quick at taking in pictures as a whole and in detail. Time yourself, then turn to page 154.

Have You a Good Vocabulary?

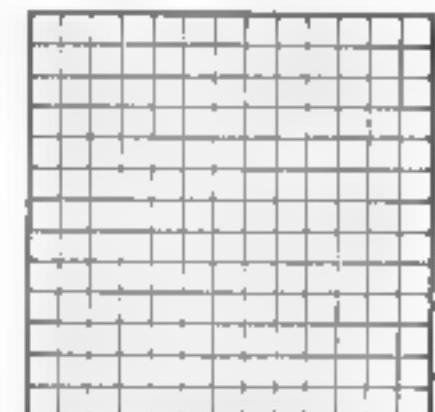
STUDY for a moment this example of a word square. Notice how the five words can be spelled vertically as well as horizontally:

C	H	A	L	K
H	E	L	E	N
A	L	I	V	E
L	E	V	E	I
K	N	E	L	L

Can you construct a similar square from five five-letter words which fit the following definitions?

A rector; a lazy fellow; a girl's name; books, to rub out.

Tests of this kind draw upon your vocabulary and show your readiness with words. Note the time you take, then turn to page 154 for your rating.



A Test of Analytical Ability

YOUR success at this quilt puzzle should establish your claim to high analytical ability and keenness of perception with geometric forms.

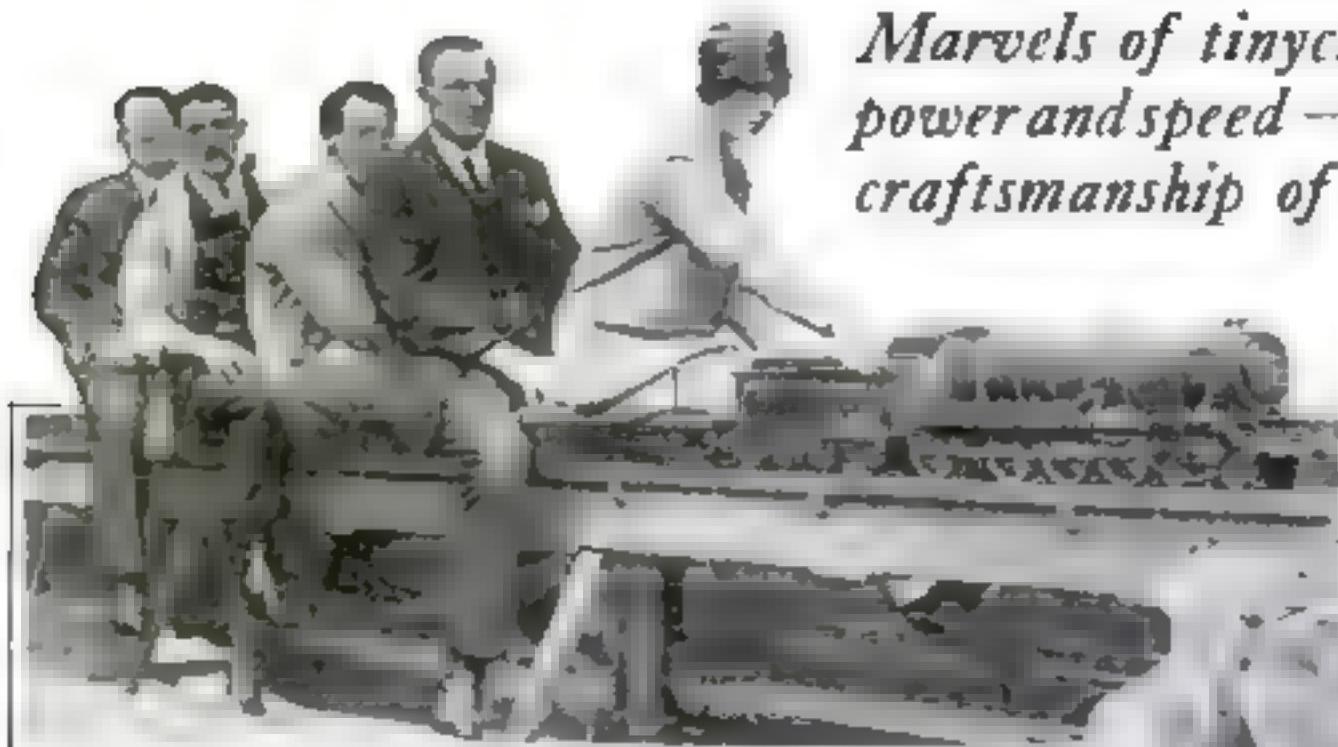
An old lady received for Christmas a beautiful patchwork quilt which represented the handiwork of eleven granddaughters. Each girl contributed a square piece made up of one or more little squares, and these square pieces of varied sizes were joined together to form a 19-by-13 quilt as shown above. It required considerable ingenuity on the girls' part to unite the square pieces. Can you chart the original eleven contributions on the "quilt" above?

Time yourself, then turn to page 154 for your rating.

Sam Loyd, most famous puzzle maker in the world, offers readers of POPULAR SCIENCE MONTHLY something more than mere brain-twisters, in the puzzles appearing on this page from month to month. As tests of your mental abilities they are an aid in judging yourself, as well as a source of entertainment.

Model Making Lures America

Marvels of tinycraft show amazing power and speed—Could you equal the craftsmanship of those shown here?



A TINY speed boat, less than three feet long, went tearing down the lake at better than a twenty-mile-an-hour clip. A plume of spray shot out at each side. The bow was well out of water, and as the little boat skated over the surface a staccato roar came from the miniature, homemade gasoline motor that spun the propeller several thousand times a minute.

"That's what I call a \$12,000 thrill for \$12.00!" a man standing next to me shouted. "All the thrills and none of the danger!"

We craned our necks to see whether the tiny speed boat would crash against the bank before the owner, running along the edge of the lake, could get there in time to save his craft.

"Yes, sir!" went on the man at my side. "I've been building model speed boats for years now, and each time I start one off I get as much kick out of it as if I were at the helm of a Gold Cup racer. My pocket-book couldn't stand buying even the exhaust pipe on one of the full sized speed boats, but I can act like a regular multi-millionaire in the model speed boat game. If one gets smashed, I can fix it with a few dollars' worth of parts and a little time spent in my shop. I try out all kinds of new ideas to get more speed. Just now I'm working on a new type high pressure flash boiler that's sure to give me at least three miles more speed."

I HAD gone to a park near my home as a result of a brief item in the newspaper that a model speed boat regatta was to be held. To my mind had come a hazy picture of miniature boats crawling over the surface of the water at about the speed of a lazy goldfish.

But here was something I hadn't pictured, something that very quickly dispelled my earlier impression. Here were skillfully built racing models. Featherweight hulls carried two, three or four-cylinder, homemade steam engines connected to tubular boilers. Small gasoline blowtorches burned with roaring flames under the minute boilers, generat-

A Little Giant of Steam Power

Of all models challenging the model fan's skill and ingenuity, the steam locomotive heads the list. The little marvel above, at a model exhibition in London, hauled half ton loads with ease!

ing a steam pressure up to 100 pounds!

I found that model making is an increasingly popular hobby throughout America. Almost every community has one or more followers of the pastime, and groups of them have clubs in all of the larger cities of the country. Canada, also, has several very active clubs, and in England model making is even more popular than here.

Models of almost every conceivable type of machinery have been built by

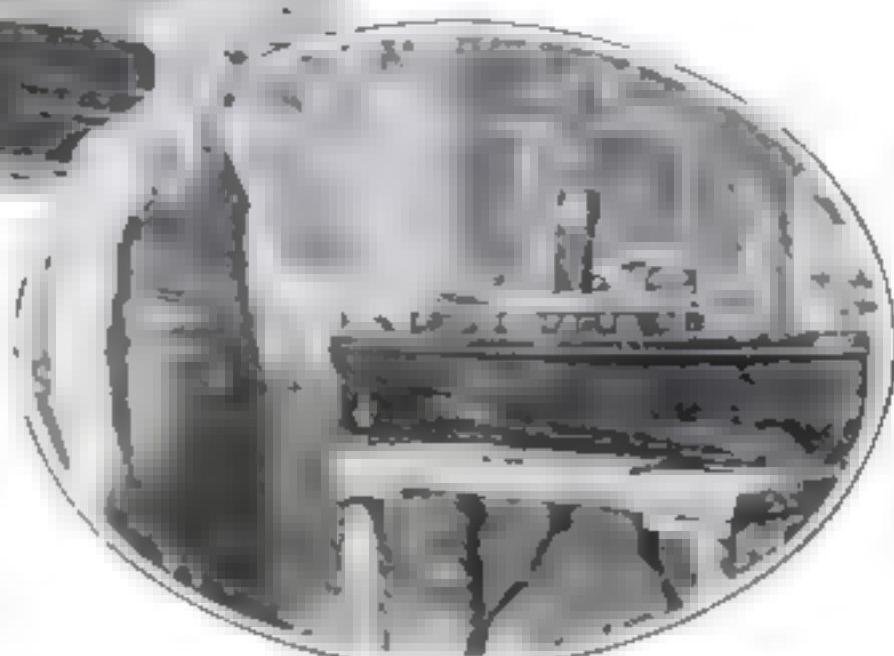


A \$12,000 Thrill for \$12!

Rounding a turn at twenty miles an hour Model speed boat builders match their tiny craft with as much zest as millionaire yachtsmen, and keen rivalry exists between advocates of gasoline-driven and steam-driven racers.

Product of His Own Skill

William T. Fernald, of Mount Vernon, N. Y., says no man he ever had could equal that when his miniature tug, below, was finally completed after eight months of effort. A thing of beauty, it is perfect in every detail.



members of these organizations. Railroad miniatures are especially popular, ranging from a tiny track measuring only five eighths of an inch between rails to locomotives such as you see pulling trainloads of people at fairs and amusement parks.

Marine models also attract widespread interest. Speed boats, such as were displayed in the park, are only one branch. Thousands of model boat fans are interested, for example, in duplicating in miniature water craft other than speed boats, from the harbor tug to the ocean-going liner.

BUT it is in the building of a scale model of a steam locomotive that lies the greatest challenge to the skill of a competent workman. Many craftsmen do not stop with locomotives. They build and operate complete systems in small gage with every detail of equipment in miniature, including elaborate signal and switching apparatus. Stationary steam engines are also popular, as are tractors and automobiles.

Model making, I found, has become an important factor in many lines of industry, because it is often possible to try out new mechanical ideas on a small model and save the expense of full sized experimental machinery. This applies particularly to complicated machinery of large size, where it is difficult to visualize the completed machine from the blueprints. A great tool works, for instance, recently used a model to determine the proper shape and proportions of a gigantic car

To a New Pastime

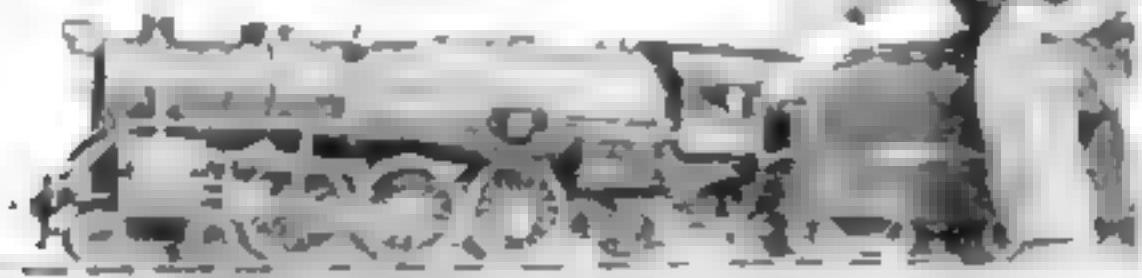
By John E. Lodge

wheel boring mill and as a result saved thousands of dollars.

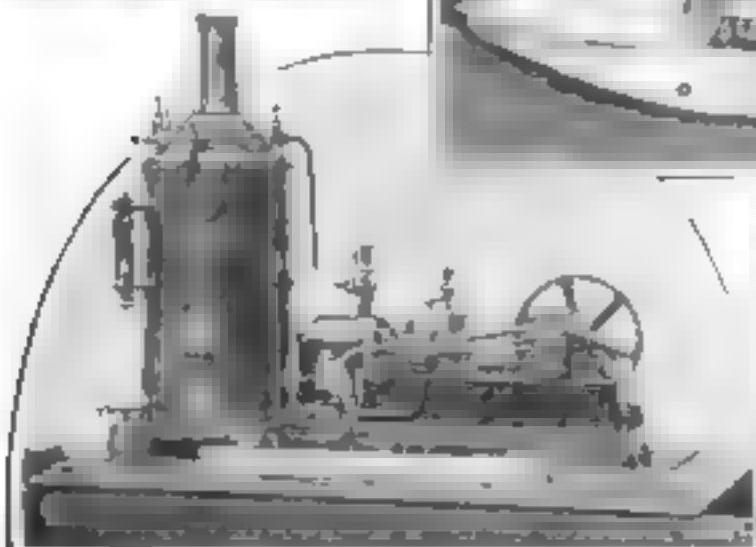
I talked with a number of model enthusiasts. The reasons they give for their pastime are as many and varied as the devices they make.

"The thing I like best about this model-making hobby," explained one man who makes a specialty of building models of fire-fighting apparatus, "is that you don't have to stick to any confounded rules. Of course, if you are building speed boats to enter in a model competition, you have to follow the rules, but in ordinary work you have a chance to exercise your own ingenuity. If you want to depart from strict scale dimensions to make a better working job, there's no reason why you shouldn't."

THREE perhaps is the reason the hobby has such a strong hold on so many people. It permits a man to develop his skill with tools and his ingenuity and inventive powers at the same time. Model makers will tell you that some of the men now prominent as the heads of our biggest manufacturing concerns are model makers. Walter P. Chrysler, famous automobile engineer, points proudly to a remarkably accurate scale model of a steam locomotive which he built and operated on a track in his back yard. Others have found that model making developed skill in working out difficult mechanical problems. Howard Greene, designer of intricate motion picture cameras for the Department of



J. M. Thrift, of Tucson, Ariz., built the elaborate steam windmill we all see. The windmill is
gigantic at the top. It is built



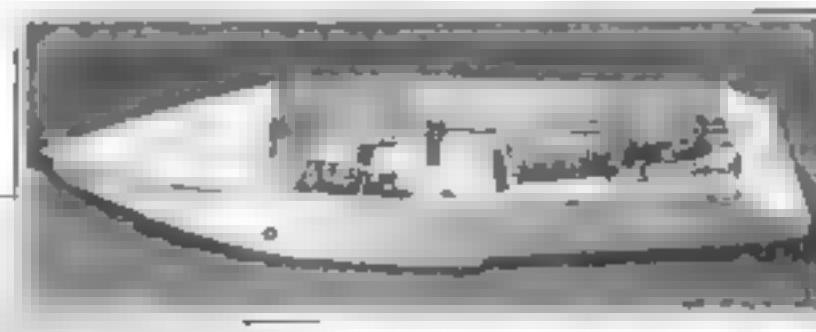
J. Wood, of Winnipeg, built this stationary steam engine model, with its coal-fired tubular boiler, force feed pump and speed governor. It runs continuously for over two hours.

Agriculture, recently wrote this to *POPULAR SCIENCE MONTHLY*:

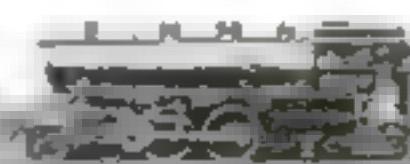
"I have been a professional machinist but I find that the ordinary machinist's training is by no means sufficient for the work of designing and building scientific instruments, which requires the somewhat peculiar training that a model maker gets if he really digs in earnestly. I find that, though I have at my disposal a large machine shop and good machinists, they can't do my work, so I have a little shop of my own and do it myself."

ON THE other hand, model making serves as a source of pleasure and relaxation to countless men who are engaged during working hours in totally different occupations.

"It is the best antidote for brain fog I have found yet," explained a lawyer whose practice runs to highly technical and complicated civil actions. "It seems strange that the mental effort necessary to solve a knotty problem in model making should act as a panacea for legal worries. I suppose it is because the work is so entirely different and the concentration drives my mind out of its usual rut."



Built a model and software of system
on which a general approach can be
used to solve problems. This will
be a kind of Network Function.



Mr. Wood with another of his models, a steam locomotive that easily hauls himself and his small son around a track and out to the back yard. Models such as this promise enterprising skill quite as much in its work as the building of gigantic structures.



Hauls a Boatload of Four

Eric Able, president of a model makers' club in Winnipeg, Canada, holding the steam power plant of a model river tugboat built by one of the members of the club. With full head of steam, the miniature tug pulled a small boat loaded with four grown-ups.

Patience and perseverance in overcoming obstacles seem to me to be outstanding characteristics of all model makers. The work naturally develops these traits. Few model makers can afford the elaborate equipment of the modern tool room, and yet they constructively tackle the building of such marvelously perfect models as are shown on these pages. What they lack in equipment they make up in figuring out ways to accomplish the desired results without the aid of the tools ordinarily used for the job.

Where the professional toolmaker would use a highly developed milling machine to make a certain cut on a metal part, the amateur model maker, for instance, may be compelled through lack of equipment to use a file and hand saw.

A MAN living near my home is finishing up the work on a steam locomotive that is true to scale in all essential working parts. Yet he hasn't even a bell. The engine is full of all sorts of the most curious. It can't possibly be a traction engine in order to impress by its sound. I wonder how you would like that engine?



Mr. Wood with another of his models, a steam locomotive that easily hauls himself and his small son around a track and out to the back yard. Models such as this promise enterprising skill quite as much in its work as the building of gigantic structures.



He Finds New Speed for Light

The speed of light. Albert A. Michelson, of Chicago, now puts the speed of light at 186,284 miles a second, correcting the figure of 186,326. New experiments with octagonal mirrors, as he is demonstrating above, on two mountain tops, gave the more accurate figure, which will now be used by scientists.

On these pages are presented each month brief stories of scientific discovery and research having practical bearing on our everyday problems.

Is the United States Sinking?

PROPERTY owners on the shore lines of the United States who have been disturbed by scientific theories that the continent is sinking, at least in part, may have their fears reinforced or allayed by a Government survey just undertaken. There are two possible explanations of the apparent lowering of the Atlantic coast at the rate of one or two feet a century. One is the gradual sinking of the whole continent, the other is changes in the sea level. To solve the mystery, geologists have just begun a series of studies along the Atlantic shore line.

Already tide gauges have been installed in Jamaica Bay, Long Island and in New York harbor by officers of the U. S. Coast and Geodetic Survey. Other studies will be carried on at Eastport, Me., and St. John, N. B.

The investigations not only are of interest from a purely scientific standpoint, but affect every owner of property along the ocean. Where waves attack the coast, the value of property may be determined largely by the probable future rate of coast erosion and by the extent of engineering works required for protection against this erosion.

Fighting Fire with "Snow"

BEFORE many months we may see firemen fighting a stubborn blaze, not with powerful streams of water, but with batteries of superecold snow! A remarkable new fire extinguishing process, devised in Germany, employs a snow of carbon dioxide gas, the same gas that makes bubbles in soda water. The snow is cooled to more than a hundred degrees below zero.

Because of the ability of carbon dioxide gas to smother a fire, it has already been used in some types of fire extinguishers.

Science Extends "Snow" for Fire Fighting, Radium

In the new process the gas is liquefied under high pressure in strong steel cylinders. When a fireman opens a valve of one of these cylinders, the escaping liquid instantly freezes into snowflakes, which are blown over the fire. The intense cold of the snow crystals combines with the smothering effect of the gas to put out the fire.

How's Your Bed?

IF YOU earn your living mainly by brain work instead of manual, you can save at least two hours of rest every night by sleeping on a good, soft bed. Such is the conclusion reached by

Dr. Donald Ladd, head of the department of psychology at Colgate University, following a series of interesting experiments with students. By measurements of mental reactions in terms of calories, he found that a soft bed will build as much mental energy in six hours as a hard bed will build in eight.

Mars May Really Have Martians

ASTRONOMERS who trained their telescopes on Mars during its latest visit in our neighborhood a few weeks ago, made two important discoveries. Measurements of the temperatures, made by Dr. W. W. Coblentz of the U. S. Bureau of Standards and Dr. C. O. Lampland at the Lowell Observatory, Flagstaff, Ariz., show conclusively, they say, that there is sufficient warmth for animal and plant life. They place these temperatures at seventy degrees and above.

At the same time Dr. E. M. Antoniadi, working at the Meudon Observatory near Paris, observed significant changes in the shapes of dark areas, strengthening the

belief of leading astronomers that the dark patches, bluish-green in color, are areas of vegetation.

Thus, while as yet there is no proof that life exists on Mars, scientists now have proof that it is not impossible.

Discover Filter for Radium Rays

FIVE years ago the women of America bestowed upon Madame Curie, discoverer of radium, a gift of one twenty-eighth of an ounce of the precious element, worth \$100,000. Today the gift has been turned into profit for all the world, for workers in Madame Curie's laboratory in Paris now have found a way to prevent injury to the flesh of a patient during radium treatment.

The method is to wrap the radium tube in a sheath of a dense metal, such as platinum, and many layers of gauze, providing a filter for the rays that are needed.

Finds Goats Living in Tree Tops

GOATS calmly pasturing in tree tops were one of the strange sights seen by Dr. David G. Fairchild, of the U. S. Department of Agriculture, on a recent botanical tour around the world. A large part of southern Morocco, Africa, he explains, is overgrown with forests so gnarled and grown together that the ground under them is quite barren. Consequently the only pasture for the natives' goat herds is in the branches, and the animals have become expert climbers. They have regular paths and runways among the branches, and live on the leaves and yellow, plumlike fruit!

Greek Tomb Yields New Treasure

JEWELEY that for magnificence and marvelous workmanship challenges comparison with the best of today, though it was produced 8,000 years ago, has come to light in an ancient beehive



Just what effect antifreeze solutions have on cars, besides their legitimate purpose of preventing freezing, is the subject of tests at the U. S. Bureau of Standards. H. E. Cummings, chief of the automotive section, is shown with the complicated apparatus specially constructed for these tests. Particular attention is being paid to the corrosive or rusting effects of the solutions.

Its Chain of Conquests

Filter, Bottled Oxygen among Advances

tomb in Greece. Called the most important find in Greece in thirty years, the treasure includes golden drinking cups, necklaces of gold rosettes, ingot rings and other ornaments and vessels.

It was discovered by a group of Swedish archeologists headed by Prof. Axel W. Persson of Upsala University, after peasants had been noticed removing flat stones from a tobacco field near Midea. The debris was cleared away, and the skeletons of a king, queen and young princess were found. The art objects, contemporary with the tomb of Tutankhamen in Egypt, are now being studied in the Greek museum at Nauplia.

High-Speed Radio Links World

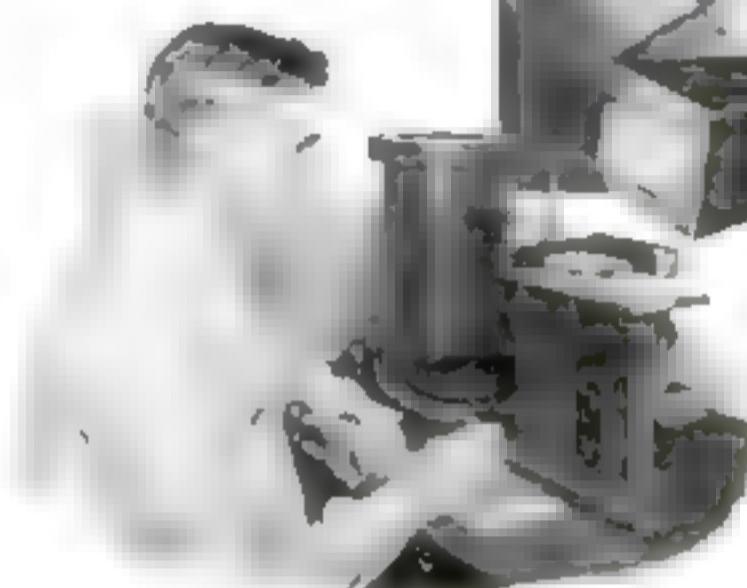
WITH the inauguration of high-speed, semi-secret wireless service between England and Canada, using the new Marconi beam system of transmission, another important step in world communication was taken the other day. The next few months will see all the continents of the world linked by new "beam stations" in British possessions, thus virtually girding the globe with an amazingly swift operating system of commercial radio. The system will be under the control of the British Government.

The beam system differs from ordinary radio transmission in the same way that a searchlight differs from an ordinary lamp. Whereas the usual broadcasting station sends out radio energy in all directions, the beam station concentrates it in one definite direction.

The result is extraordinary speed of transmission. In the England-Canada

Testing a Bee's Habits

Scientists of the U. S. Department of Agriculture are learning new facts about bees, by remarkable tests. The instrument at right shows their industry or laziness at honey gathering by tracing a record of their weight. That below tests their color sense.



service, 1250 letters a minute may be sent in either direction, or 2500 letters a minute over a complete circuit. At the same time much less power is required.

Skin Rashes from Odd Causes

EFFECTS like those of poison ivy are produced on the skins of many persons by substances they come in contact with in their daily work, reported Prof. Max Touton of the University of Wien.



baden to a recent German medical congress. Viobu players are poisoned by the resin they use on their bows, flute players by the grandella wood of which their instruments are made and hair-dressers by the quinine in their tonics. Packers in drug houses are given the skin disease by such drugs as squills, and workers in vegetable packing houses are poisoned by the vegetables.

Efforts to build up resistance by inoculation with small doses of the trouble-causing substances, said the professor, are meeting with at least partial success.

How Your Hair Can Betray You

ANY hair on your head is just as certain a mark of your identity as are your finger prints. That criminologists make use of this scientific fact was disclosed in recent reports of the importance attached to a single red hair in the notorious McPherson case in Los Angeles.

Scientists say that human hair, examined under a powerful microscope, has tiny overlapping scales, much like the scales of fishes. In the center of the hair is a hollow canal containing the coloring matter.

In no two individuals, they declare, is the hair structure exactly the same. Among the points of identification are the size of the hair, size of the central canal, size of the scale-like units, and the nature of the hair surface.

Bottled Oxygen for Aviators

CLIMBERS of the air will be enabled to reach a higher "ceiling" than ever before, it is expected, with the invention of a thermos bottle in which the aviator can carry his supply of oxygen in liquid form. Heretofore fliers attempting high altitudes have carried oxygen in the form of compressed gas in steel cylinders.

The oxygen bottle, invented by a member of the French Academy of Sciences, contains an electric lamp which vaporizes the liquid oxygen as needed.



Atomic Models Aid Search for Secrets of Matter

What atoms would look like if we could see them with the naked eye is shown in the remarkable models with which Henry D. Hubbard, above, of the U. S. Bureau of Standards, is experimenting to find new secrets of matter. The models, as well as the chart, show the different ways electrons and atoms group themselves around a nucleus or in crystals to produce hard and soft substances, such as diamonds, benzene, helium, graphite or potassium.



Head Structure Also Important

Physiognomy—the science of studying character from the features of the face and structure of the head—lays special emphasis on the mouth, nose, eyes and eyebrows. Each of these features, physiognomists say, is pulled into its ultimate shape by our dominant emotions and habits of thought. Dr. Milton J. Greenman, of the Winter Institute, above, is studying skulls of criminals to know whether there is a distinct cranial type

TWO years ago the president of a large eastern corporation made his annual pilgrimage to a mid-western technical college for the purpose of selecting from the senior class enough men to fill his requirements for engineers. The dean, a friend of many years' standing, welcomed the manufacturer cordially, but expressed surprise at his premature arrival. It had been his custom to time his visit immediately after the final examinations, which served as an index to the embryo engineers' abilities.

This year, however, the men had yet to take their tests when the visitor arrived, and he straightway proceeded to break another precedent—that of interviewing each young man before making his decision.

"Just give me a chance to look them all over at my leisure," he told the astonished dean. "That's all I ask."

The dean led his friend to the assembly hall, where the senior class was holding a meeting. Taking a position where he could observe without being seen, the manufacturer scanned the attentive faces of the student body. After an hour of intensive search he had singled out fifteen, and then went to the dean's office to make a note of his selections.

As a rule a technical school has little difficulty in placing a majority of its graduating students. A certain amount of its output is virtually contracted for each year by manufacturers in need of trained men. This particular school, with a reputation for scholarship, attracted manufacturers of high standing whose plants offered excellent opportunities for bright young engineers. The dean's visitor was one of these.

THE most puzzling part of this man's mystifying performance was that the selections he had made numbered only half his usual annual total. Back in his office the dean remarked his friend of that.

"You know you have selected only fifteen?" he asked.

The manufacturer nodded.

"A little business depression, perhaps?" suggested the dean.

"Nothing of the sort," laughed the other. "Never better."

"Then why—" the dean began, but the other cut him off.

"I can't explain now," he said. "Next year, perhaps." And with that he took himself off.

The reason for the employer's reticence

Which Type Are You?

The ideal position for the ear, says physiognomy, is two-thirds of the way back as shown here. Too far forward, they say, betrays an excess of sensual nature.



was simply a matter of pride. He was making an experiment—to him, an extremely radical one—which he did not wish to explain until he had an opportunity to give it a thorough test.

Evidently the radical departure proved successful, for he followed the same procedure on his visit last year. The dean could contain his curiosity no longer.

"You said last year," he reminded the manufacturer, "that you would tell me what it's all about."

"It can be explained in one word" replied the other. "Physiognomy."

He went on to say that he had become interested in the application of that so-called science to the classification of men

EVEN if you do not agree with the physiognomists, you will find Mr. White's article stimulating reading. From the time of Aristotle, who was the first writer of record to attempt a classification of humanity on the basis of character, physiognomy has had the serious attention of mankind. Most modern scientists do not endorse it, but the subject is of endless fascination to the layman.

according to their business abilities; becoming engrossed to such an extent that he decided to try it out himself.

"And how has it succeeded?" asked the dean.

"Admirably. Not only are the men of uniformly better quality, but they seem to accomplish more work. As you see, I'm taking only half the customary number."

The dean smiled ruefully.

"Yes, I see," he said.

OF ALL the "ologies" and "ognomies" for which their proponents claim the ability to take the measure of a man's character, perhaps none has won such a hold on the public mind as physiognomy. In recent years its scope has widened. Originally practiced as a means of judging an individual's characteristics, it has of late come into use in the selection of business types and the detection of criminals. A still more recent application is its use in determining an individual's predisposition to different types of disease.

Everyone practices physiognomy to some extent. We speak of a man with a "frank, open countenance"; of another with "treacherous eyes"; possessors of "weak chins" have always had the reputation of being indecisive; we form instinctive dislikes for persons because we think they have "crafty-looking" mouths.

Our conclusions, however, are arrived at usually in rather haphazard fashion. Probably your system does not agree with mine. Physiognomists, on the other hand, have formulated an almost iron-clad set of rules. Apply them carefully, they say, and you've got your man charted.

FOR a complete analysis you must observe the following features: the forehead, brows, eyes, lips and lashes, nose, mouth, and general contour of the face and head. The physiognomist also makes use of phrenology, or the study of head structure, in arriving at his conclusions.

Phrenologists, as I explained in an earlier article on that subject in POPULAR SCIENCE MONTHLY, believe that every human emotion or thought has its origin in a certain part of the brain. There are more than forty of these parts, covering the whole range of human thought and emotion.

In addition, phrenologists tell us, nature has grouped faculties of the same general type. In a row over the eyes are the perceptive faculties—those that enable us to distinguish forms, colors, weight, size, time, and so on. Higher up are the faculties of

Tell Your Boss?

Your Eyes, Nose, Mouth and Other Concerning Your Abilities

J. WHITE, JR.

thought. The top of the head is the seat of the qualities of veneration, hope and faith, while the back of the head is allocated to the social instincts—love of home, children, wife.

In passing judgment on the individual, the physiognomists imagine the existence of a vertical line splitting the head in two and passing through the ear. The qualities forward of that organ are principally of the mental type; those to the rear are physical. Hence a position of the ear too far back would indicate a preponderance of mental attributes; too far forward would betray an excess of animal nature.

Having determined from the shape of the head the general mental make-up of the subject, the physiognomist goes a step further and takes inventory of the face. He scans the eyebrows, the eyes, lashes, nose, mouth, lips and chin in turn, and then takes in the whole effect, full face and profile.

FEMININE ideals of beauty demand eyebrows of pencil-like fineness, and inventors have provided the girls with delicate instruments to narrow their brows down to a thin line of a half dozen hairs. They suffer considerable torture to achieve that effect, but not half the anguish it causes the physiognomists when they view the result; for the faintly marked eyebrow, we are informed, is the sign of a vacillating nature, a negative personality and a weak constitution.

The ideal eyebrow is set at right angles to the nose, is full, yet somewhat compressed, with the hair running all the same way, and seems to bear down upon the eye. If, after an inspection of yourself in the mirror you find yourself amply equipped, you have cause for pride, since that, the physiognomists say, is the brow of the successful man, one who is inclined somewhat toward inventive lines. He will be strong physically, intense and energetic, and will have a captivating personality. When the eyebrow gets a little rough so does the subject. A wavy, bushy, erratic brow is supposed to give signs of an erratic, though at times brilliant, individual.

PHYSIOGNOMISTS are most emphatic in their warning that no attempt should be made to judge a person's character until all the returns are in, weigh all the attributes before making your decision. Sometimes, they say, you may find conflicting features, eyebrows may bespeak strength, the mouth weakness. The proper

method, then, is to strike a balance and decide which is the creditor.

Thin, long, slightly arched brows with a puckery effect in the center are supposed to reveal a jealous, resentful person; eyebrows that run up from the nose, a changeable, untrustworthy nature. A pucker anywhere in the brow is read as irritability.

PROFTS and lovers, since time immemorial have laid great stress on the eyes, especially those of women. Physiognomists are just as enthusiastic about them, but for an entirely different reason. The eye, they say, is the one feature that cannot be controlled by the will. You probably are always a little suspicious about a person who refuses to meet your eyes. Of course that is with some the result of self-consciousness, but in many instances a man is afraid his eyes will betray him. Physiognomists say that the more an attempt is made to control the eye, the more it will betray to the trained observer.

It is not only the ball of the eye that the physiognomist judges, but the conformation of the upper and lower lids as well. His ideal eye is clear, slightly deep-set, with a full pupil. The upper lid droops over the ball, partly obscuring the pupil, but the droop should not be one of relaxation or the result of lack of muscular control; rather it should evince mental concentration. The lower lid is drawn up to the extent of just touching,

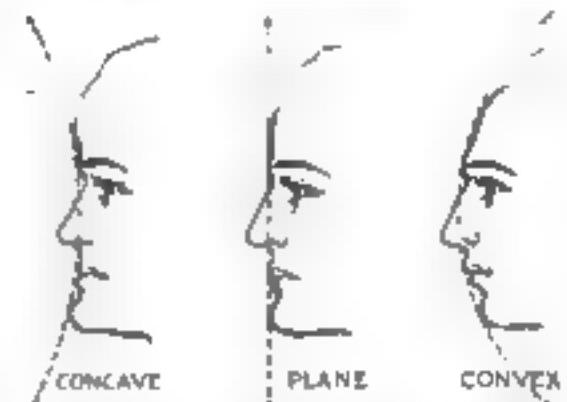


Detective Studying Types in the Rogues' Gallery

Police back up physiognomists in their belief that facial characteristics reveal mental traits, for they say that perpetrators of specific types of crime invariably look alike. Thus the "lub worker" has a long face, craggy eyes and a squat nose.



The sides eye measure exactly the same in width across the nose. Eyes too far apart, according to physiognomists, indicate low mentality; too close, narrowness of mind.



Three types of profiles as classified by physiognomy—the concave revealing the slow, deep, but determined thinker; convex, the quick but indecisive thinker; plane combining the best qualities of the other two.

or covering somewhat, the pupil. The iris is large, while the eye as a whole has the appearance of being set deeper into the face at the outside corner than next to the nose.

Using your index finger as a gage, measure the width of your eye, then see how that compares with the distance from the inner corner of one eye to the other. If they measure the same, you can ask no more, for that is a rating of 100 percent. If the distance between eyes is greater than the width of one, physiognomists say the mentality is not up to standard, while a lesser distance reveals narrowness of mind.

Eyes differ radically in shape and size. The round eye with all of the pupil showing and a small iris is a fit companion for the arched eyebrow. The glance is fixed, the ball protrudes. These characteristics reveal to the physiognomist a person of small mental endowments, a cold, mercenary nature. Small, oblique eyes, deep-set and close together, with the lids narrowed over them indicate to him deceitfulness, irritability, gloom.

THAT is the extreme type, we are told, and to be damned so completely must be found in conjunction with other unfavorable features. For example, the small eyes with narrowed lids may also apply to the shrewd but not necessarily dishonest person.

Another none too complimentary eye has a glazed look—no sparkle to it—with a thick upper lid that droops listlessly. That bespeaks to the physiognomist an aimless sort of individual, one whose sole concern is pleasure or ease, and who is lacking in courage.

Most of the rules regarding the eye follow a line of reasoning that is quite up- (Continued on page 155)



Stained Ice Windows Glow in Sun

Though they melt away when the thermometer rises, "stained ice windows" are beautiful while they last. As invented by Miss Myrtle Karsten, of Chicago, for her playground pupils, the method consists of marking designs on glass with clay edges, pouring colored water in the inclosures, and freezing.



It Makes Daylight

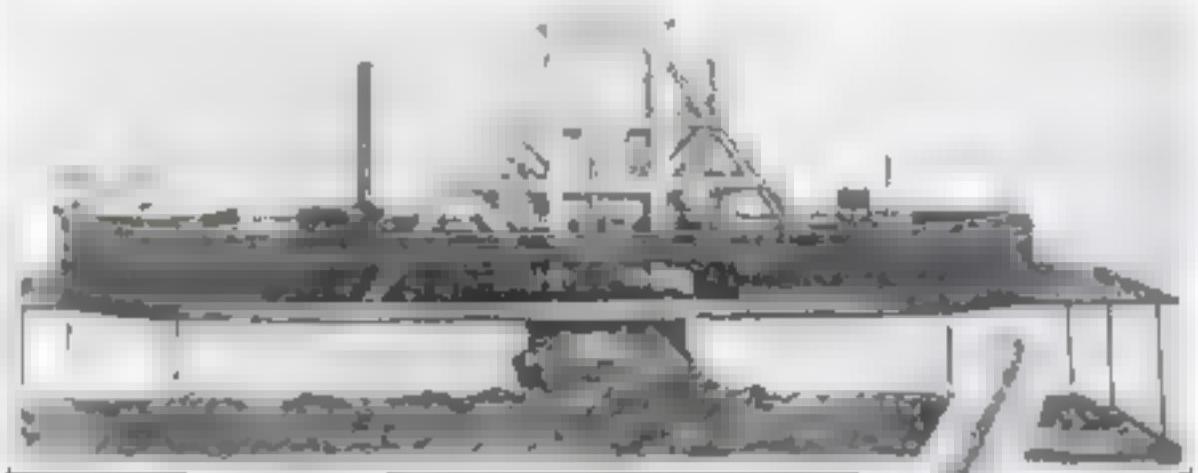
To imitate conditions under which daylight is produced, a new glass for lighting fixtures right is made of three layers fused together. A blue layer makes a miniature sky white, a cloud clear the atmosphere. Filtering through the three layers, electric light has the quality of daylight.



Who Cares for Size?

Awarded a Grand Prize in Rome for the best small car, the unusual machine below is driven by a diminutive four-horsepower motor. The smiling chauffeur is Glenn Hunter, actor, taking his family for a spin.

Odd Products of



Novel Model Diving Bell

Recently exhibited at Biel, Switzerland, the model above is a distinct departure from ordinary diving bells and the country that takes them to the scene of operation. The bell is situated amidships and is lowered into the sea directly from its position, instead of over the side.

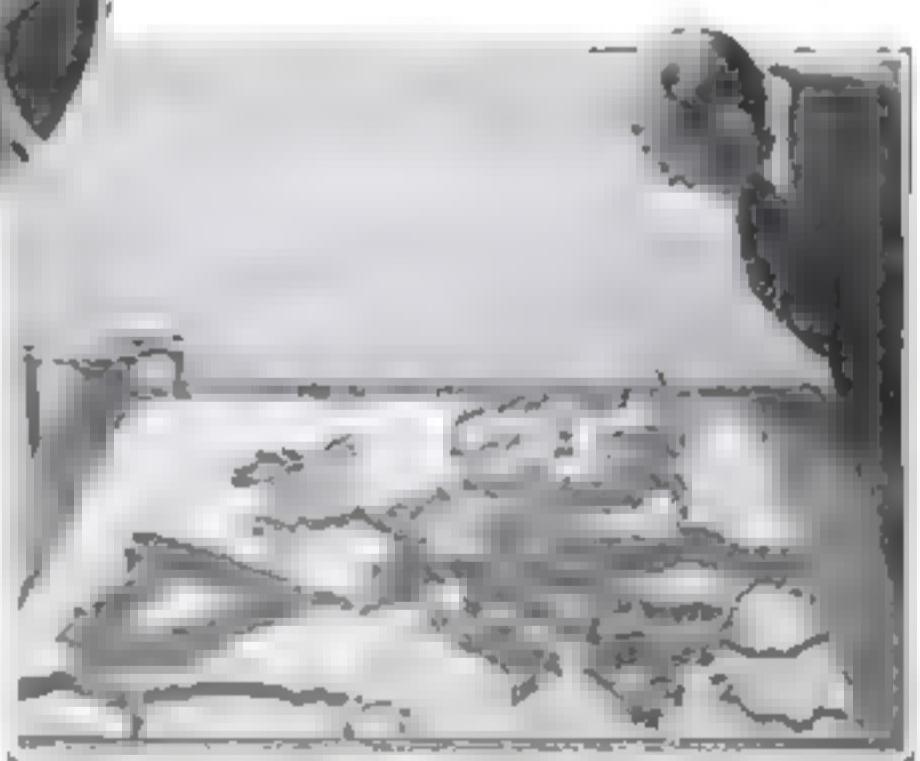
A Shipload of Sweetness

Made entirely of sugar even to the fine, sweeping masts, this bold pirate ship at the left is the creation of Eugene Bobinger, of Detroit. Mich. Ship model fans, can you beat it?



A Boy's Dream of a Real Kite

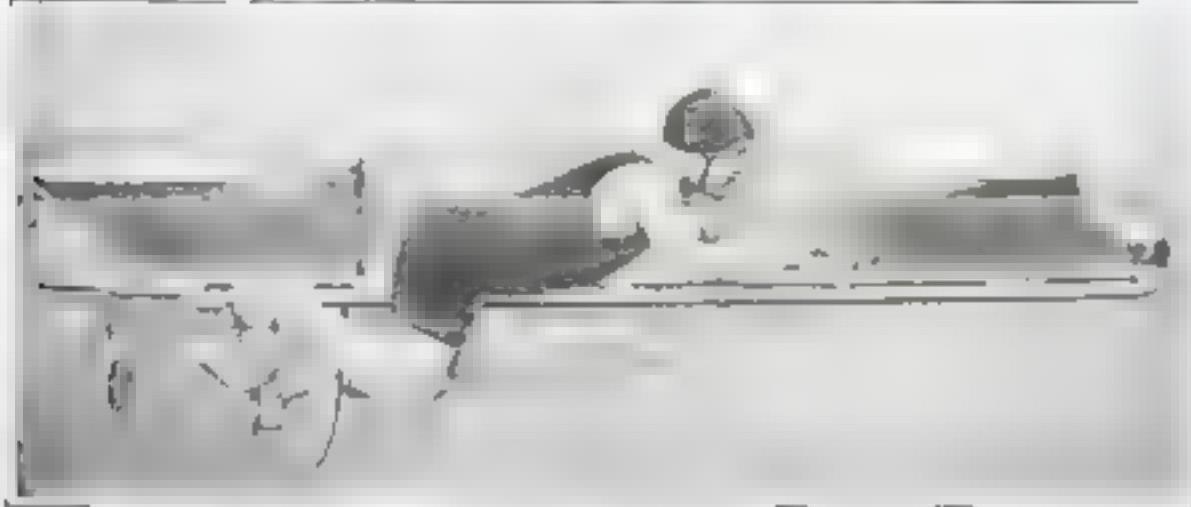
Here's a kite that at last satisfied the heart of one kite-mad boy! Flying, it measures eighty feet from head to tail. A spectacular feature is the sudden shooting of a huge butterfly from end to end. A sixteen-year-old schoolboy of Los Angeles made it.



If Tariff Walls Could Be Seen by the Eye—

Tariff barriers in Europe are strikingly illustrated by real walls on the map above, designed by a member of the British government. For example, Spain's high wall indicating her high tariff is in contrast with France's much lower wall, while Russia's wall is topped by barbed wire to emphasize her extreme restrictions.

Human Ingenuity



He Couldn't Draw if He Tried

One man's power of hand control over the pen is so great that he can draw through the window of a moving train. He has broken up the speed of the train to fit his drawing now—like



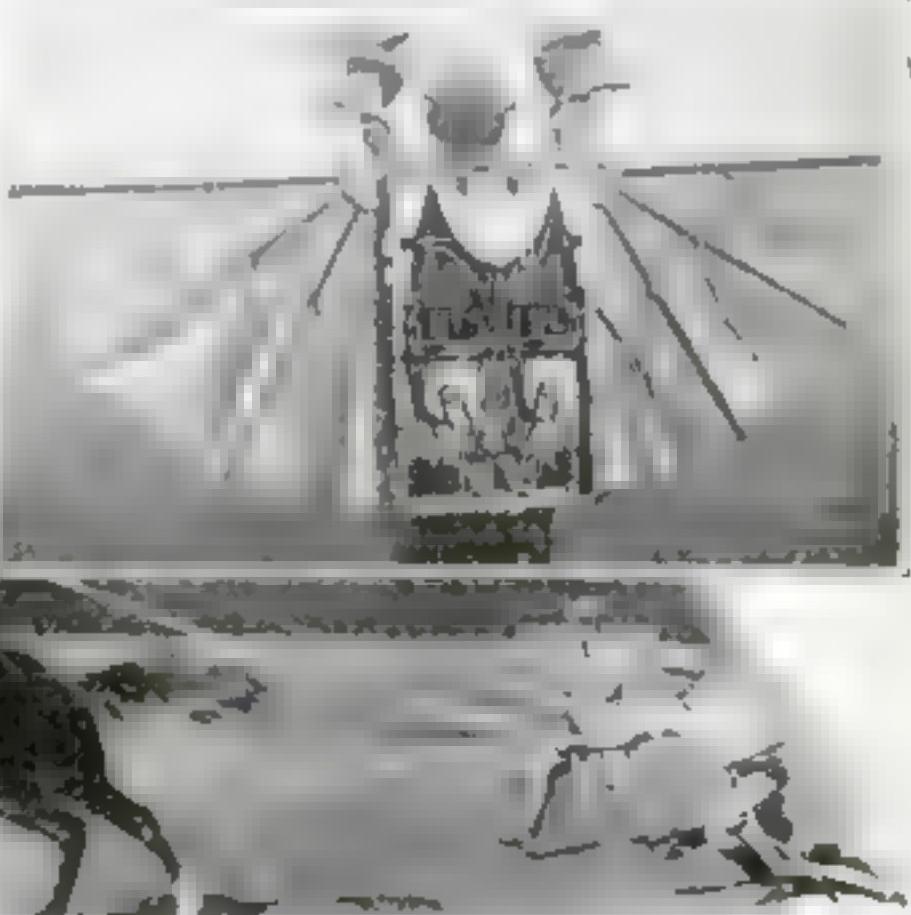
He'd Fly like a Bird!

With wings spread wide like a bird's, a man here shows the secret of flying at 100 feet. Walking toward him from the left, the wind, passing over the motions of flight



Shoots a Ring of Bullets

The recent tour of a shooting exhibition by the Americanoughsightless troupe in the Adirondack State of New York City presented a unique show. However, instead of a gun bullet or pistol shot as shown in the above picture, it is a glow



Only Daredevils Need Apply

The man above is demonstrating the correct way to hang by your feet from the wing of an airplane in flight. Plane-chasing and wing-walking are other interesting courses at the new aerial stunt school, Santa Monica, Calif.



Garage Becomes His Observatory

If you own a garage but would prefer an astronomical observatory, follow the lead of Dr. Charles W. Bullock of Buffalo, N.Y. He added an iron-domed tower left, and now, instead of worrying about auto repair bills, studies stars

They're Only Silhouettes

Many Paris shop windows no longer display goggle-eyed wax figures. Fabrics and dresses are draped gracefully on silhouettes cut from thin pieces of board



Spare the Spur and Spoil the Horse?

British horse trainers don't think so, at least at Virginia Water, England, where horses are broken without recourse to spur or whip. The photo shows a horse bucking on the long rein used

Fire Victims Lowered to Safety in Novel Bags



Los Angeles firemen demonstrating the new rescue bag

Building Bricks Made of Paper

ALREADY we have paper fire buckets and paper car wheels, and now it appears that we may yet live in paper houses. A Berlin sculptor, Yvan Pestelich, has invented an economical building brick made of paper and seven other ingredients, kept secret by the discoverer. Fire- and waterproof, the material is said to be undamaged by nailing and to be suitable for use in one-story and two-story buildings.

In its astonishing use for fire buckets, paper is rolled into rope and pressed into shape. A coating of bright red paint completes the bucket. Car wheels are pressed from a kind of paper known as calendered rye-straw board under a terrific force of five hundred tons. Circular sheets are made into wheels by being smeared with flour paste and pressed together into solid blocks. Steel tires and iron hubs are added, and the finished wheel shows a rigidity more than sufficient for heavy railroad service.

What Gas Will Do

AGAS company has figured out that 1,000 cubic feet of gas will: Cook eighteen meals for six persons, heat shaving water for 1,000 days, roast sufficient coffee to make two cups daily for seventy years; light two cars a day for 500 years; boil 275 gallons of water, bake 1,700 three-quarter-pound loaves of bread in a continuous oven; do the work of two hens in hatching eggs; broil seventy-three-pound steaks; barbecue enough ham to make 1760 sandwiches.

BUILT WITH such amazing delicacy as to include the wings of flies among its working parts, a new instrument has been nearly completed by Andrew Cramer, master craftsman of the Smithsonian Institution, Washington, D. C., to be used in measuring infinitesimal quantities of heat in the spectra of distant stars.

LOWERED to safety in this novel bag, a fire victim may be placed in an ambulance and rushed to a hospital still completely incased in it. A useful form of stretcher, it enables an injured person to be handled expeditiously with a minimum of discomfort to the sufferer. Straps fasten him securely to the framework, while other fasteners close the covering tightly about him, so that the enfolding fabric may protect him from smoke and injury as he is let down to earth. The photograph, taken at a demonstration test, shows how this is done.

W. H. Blake, the inventor, is automobile driver for Rescue Squad No. 1 of the Los Angeles, Calif., fire department. He suggests that the device may also be used as a strait jacket, to quiet a delirious or insane patient in the gentlest possible way.



Toy Phonograph Plays Records

"**J**UST like grown-ups have" is the miniature phonograph, made of sheet metal and a real working machine, that stops, starts, and plays like the larger models. The reproducer and horn, of light construction, are mounted to swing together across the face of the record. A clockwork motor spins the turntable, which accommodates the small records, standard among several manufacturers.

A "Vacuum Cleaner" for Mines

WITH the growing use of pneumatic air drills for boring holes in rock preparatory to blasting, has at last come a possibility for minimizing that great danger to miners—rock dust. Drilling in rock by any method fills the air with rock particles, which, breathed in by the miners, cause serious lung troubles. Now, by an ingenious new air device, invented in England, which can be used with air drills, the dust is prevented from spreading to the air. At the point where the drill enters the rock, the dust is sucked up by an exhaust draft activated by spent air escaping from the drill. The device is thus an odd sort of vacuum cleaner.

World's Biggest Organ Installed

WHEN the world's greatest organ, in Liverpool Cathedral, England, is being tuned, the workmen have to communicate with the assistant at the keys through no fewer than seventeen telephones! This huge instrument was completed only a few weeks ago, having been started before the war. It has 10,864 pipes, and electropneumatic action. The pipe playing the lowest note is a yard in diameter and weighs more than a ton.

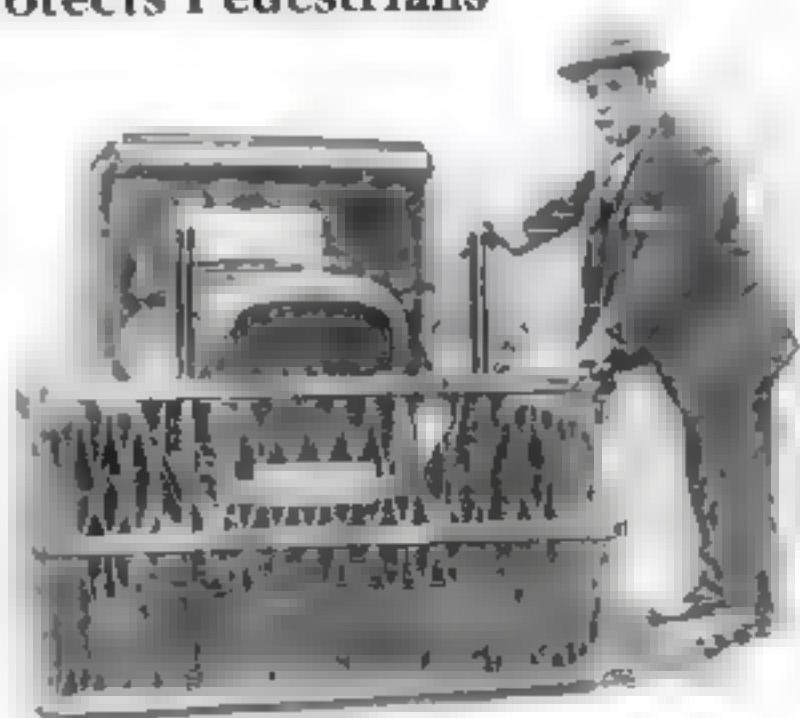


Now the Loudspeaker Fiddle!

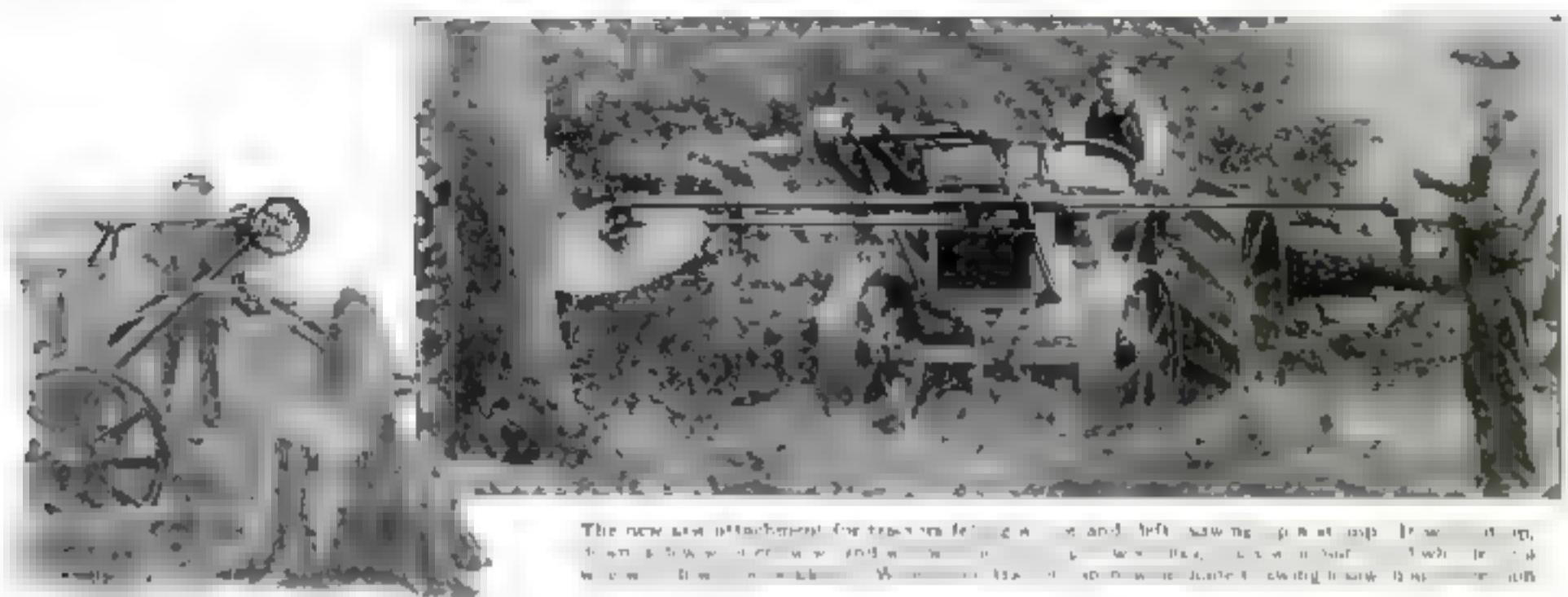
LIKE five fiddlers playing at once is this violin with a built-in amplifier which Vincent Lopez, famous orchestra leader, is examining. It gives the modest violin a star rôle among the more powerful instruments of a jazz orchestra. Its inventor calls it a "violinofon."

Auto Bumper Protects Pedestrians

IT'S almost impossible to be run over by an auto that carries this newest safety bumper. When not in action, it resembles any other triple bar bumper. But when the emergency brake is applied, the lower rail with its screen of steel chains drops down to within an inch of the ground, while the upper one is lifted an equal distance. The photo shows the inventor, Giuseppe Gaglio, of San Jose, Calif., demonstrating the new bumper.



Tractor Saws Logs and Fells Trees with New Attachment



The new saw attachment for tractors fells a tree in five seconds and cuts logs up to 12 inches in diameter. It can also be used for sawing brush, stumps, and logs.

and left sawing up a log. It will cut up to 12 inches in diameter. It will fell a tree in five seconds and cut logs up to 12 inches in diameter. It will cut up to 12 inches in diameter.

CHUG, chug—here comes the sawmill! Making a sawmill out of a Fordson tractor is the feat accomplished by an ingenious new attachment. A circular saw swung from the front of the tractor. The device moves in the hands of the operator to cut in a horizontal, vertical or slanting position. This is by virtue of the universal suspension, a further refinement enables the saw to be pushed forward along its shaft or drawn back without moving the tractor.

Power supplied through a belt to a series of geared shafts drives the saw at a high rate, with a "tooth speed" or linear velocity at the outer edge of 10,000 feet a minute—twice the speed of an

express train. The fast cutting of this saw is easy to understand when it is recalled that the old-style drag saw moves at about the same velocity as your foot in walking.

The saw attachment falls trees, slashes brush, and saws up limbs, poles, logs and stumps. It does not appear necessary to use a big saw to fell a large tree, says the inventor, V. L. Holt, of Portland, Ore., as the saw can be used as a woodsman uses his axe. By taking advantage of its slanting adjustments, the device can be employed to remove stumps to a depth of one foot below ground. A brush patch can be plowed with it, it is said, as easily as grass with an old-fashioned scythe.

According to the inventor, the attachment will fell and saw up twenty cords of oak a day, at a great saving over usual costs. If logs are too large for this saw, they would have to be split in making cord wood anyway, so no time will be lost.

Skates for Cross-Country Runs!



THREE modern seven-league boots are really roller skates, with three wheels and pneumatic tires. The "running wheels," as their German inventors call them, enable the wearer to jump at full speed over ditches and knee-high obstructions. According to the Dresden manufacturer, the speed "while traveling overland in the midst of mountains" equals eight miles an hour though leaping from crag to crag is apparently ruled out! On a good road they travel faster, without fatiguing the roller skater.

The skates have a special brake, and a single tightening lever attaches the wheels to the shoes.

Uncle Sam Builds Giant Diesels for His Ships



Engineer J. H. Baumblatt and assistant test engineer T. R. Rossmann operating the new 500,000-lb. U. S. Shipping Board Diesel engine. In an emergency, two men can operate it alone.

HAILLED as a marvel of modern mechanical genius, the great Diesel engine pictured here, made for the United States Shipping Board, is the first of fourteen to be installed in United States ships.

The new engine in a thirty-day test, burning crude oil such as is used under boilers by the Navy, consumed fourteen tons of fuel daily, a saving of sixty percent compared with steam vessels of similar power. It has four cylinders of a double acting two-cycle type, delivering power at each alternate stroke of the piston. (In an automobile piston, power is delivered only on every fourth stroke.) It delivers 2000 horsepower at ninety-five revolutions a minute. The engine is thirty-five feet long, twenty-five feet high, and weighs 500,000 pounds (a cut in weight of about thirty percent).

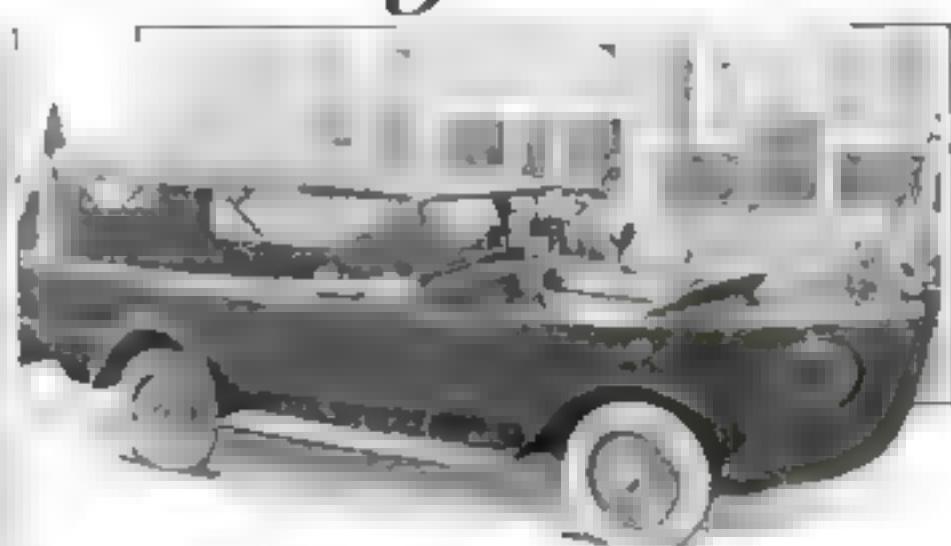
SILK SACKAGE coverings of cotton seed fiber, sanitary and edible, are being made by machinery developed for the purpose by the Mellon Institute, Pittsburgh.

Novel Devices Gathered



Street-Corner Ambulances

Parked up in plain sight in Berlin, these little ambulances are used by the German paramedics to transport wounded without arousing suspicion. They have a capacity of two patients.



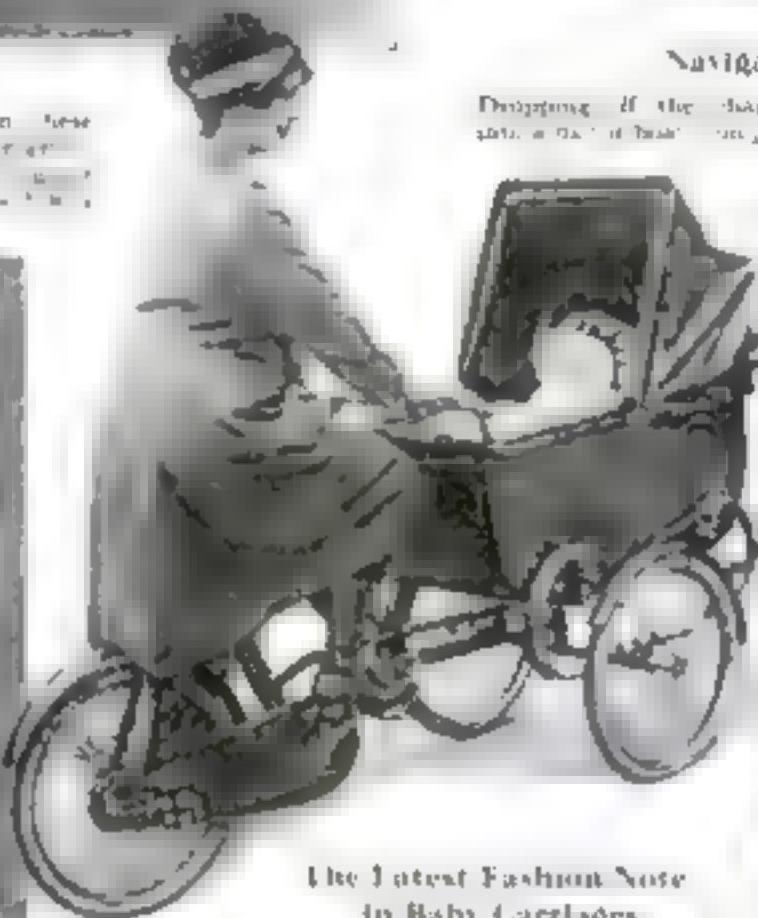
Navigates Land or Water

Dropping off the chassis, drivers of this odd-looking "tramping" car take a boat of their own design with them. It is well built and can travel over land or water.



Paints the Perfect Lip

Left: To meet such dire necessity safety must be left up to conveniences. These are not well along after using dice and they draw a fine line.



**The Latest Fashion Note
in Baby Carriages**

An unusual set of strollers designed to hold up to the time of出生, these chairs will be available in new colors in baby clothing. Note how the carriage can be turned to become the handles of a chair.



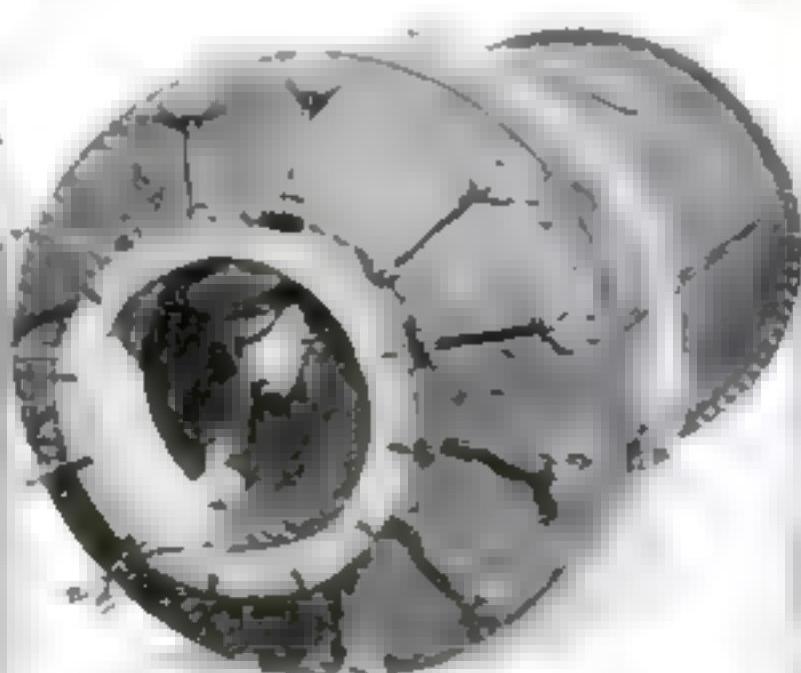
Camera for Parachute Jumping

On being 2500 feet off, a photograph taken from a sky hook, which holds the camera and lens, is dropped earthward at a rate of about 1000 feet per minute. The photo shows the lens protruding from its leather protective



Machine Gun & "Kicks" Tamed

When a gun is fitted with the new gun pointer invented by Capt. R. M. E. G. below—S. Marine Corps, the muzzle blast is diverted to eliminate the upward kick.



Diving Bell Will Aid Treasure Hunt

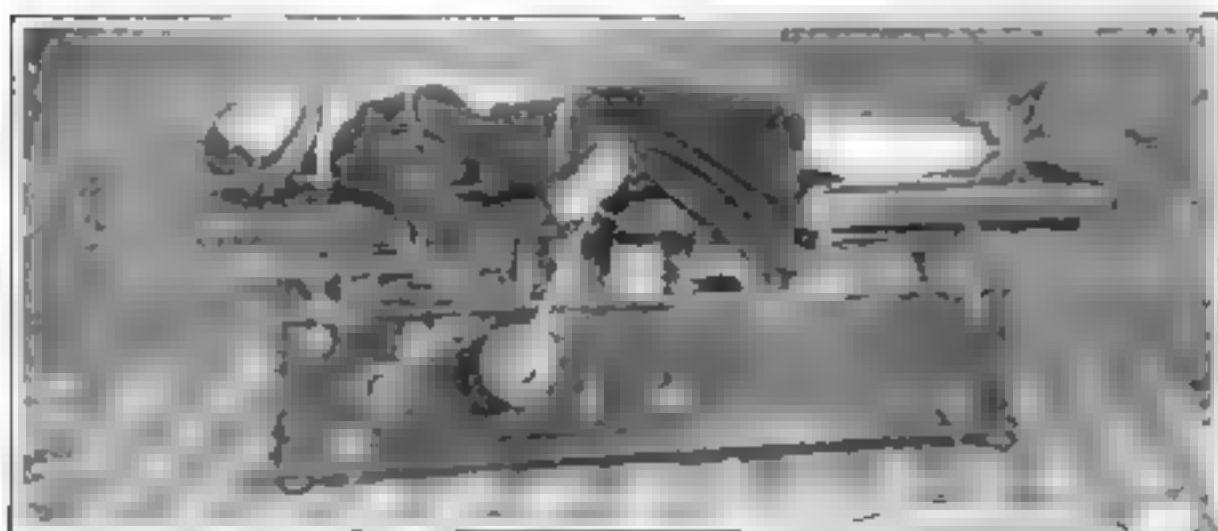
Pictured above is Capt. R. M. E. G. in his special diving suit. The suit is made of a heavy rubber fabric and Spanish murene gum. It is lined



He Knows Where He Put Them

Right: Everything a man carries in his kit umbrella panels can be put somewhere in this bag.

Here and There



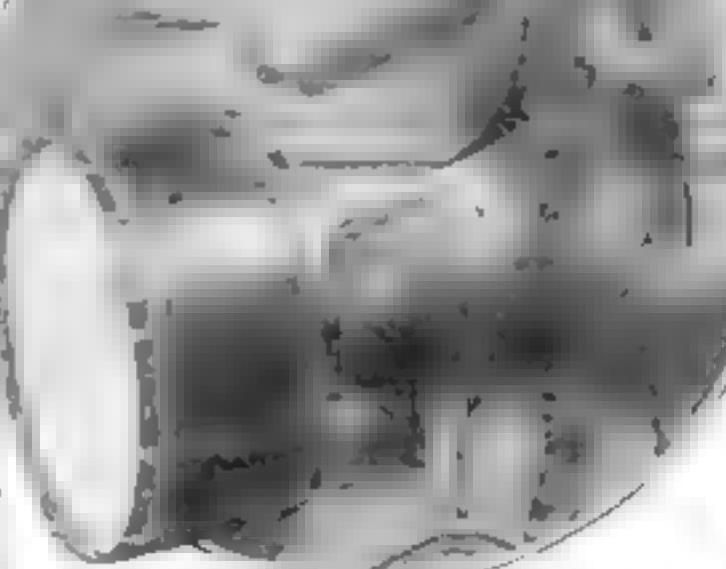
Hope for the Short Man

The elements of the machine above suggest that the first stage is to rank each of the n functions. The second stage is to select one. It can be readily implemented in hardware form and fast.



Berlin Has Armored Corps

Police of Bettendorf are trying out this sort of bullet proof armor break piece and head gear of heavy metal to protect them against the bullets of desperate gangsters.



Making Contracts Legally

Banning vehicles in the home
of the senior is essential.
This is about as far as
we'll go; it's a good start.



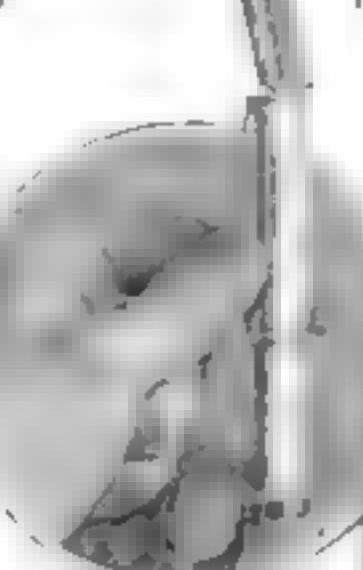
Harmonic Pitch Pipe

Books are a tremendous thing. A page is less dull than a blank wall, and it's better to have a book open than a wall closed.



Five Escape Works am Futter

Even an uncharismatic person can succeed from a burning desire in this level. A primary lesson is self-control. As we expand the circle of our influence to the next



**Closes One Way,
Opens the Other**

Hidden by buildings, a
six-lane track at New
Kensington, Pa., was
extremely dangerous so
that the swinging gate
gate was put up.
Opened for automobiles,
it's right and left auto
but only blocks the track
for trucks, now since several





Give Him a Silent Piano!

PARENTS who want their children to learn piano playing but who dread the sound of the interminable practicing, will welcome the invention of a silent piano designed especially for musical beginners. Built in a neat leather case, the device has a four-octave keyboard said to duplicate exactly the action of a real piano in all respects save production of sound. Piano action springs give a genuine "feel" to the keys, which are the regulation white ivorine and ebony.

Flashlight Needs No Battery

NOTHING is more useless than a flashlight with a run-down battery. In the Army they're considering discarding batteries entirely, and experiments are being made with a flashlight that contains its own electric generator. A spring that winds up like a clock furnishes the motive power that runs the generator. The flashlight furnishes light for three minutes with one winding.

How Much Do You Know of the World You Live In?

IF YOU are as keenly observant as you should be, you ought to be able to answer at least half of the following questions, selected from hundreds sent in by readers. Turn to page 158 for the correct answers.

1. Where do grizzly bears live wild?
2. What state has the greatest railway mileage?
3. Why is the exploration of the North Pole considered important?
4. Where did the ancient Aztecs come from?
5. What group of Islands has one for each day in the year?
6. Where does quinine come from?
7. What is the most famous prehistoric monument in England?
8. What African country is ruled by negroes?
9. What was the purpose of the Sphinx?
10. What is the wettest spot in the world?
11. Where does the United States Government maintain a volcano observatory?
12. Why are so many islands of the South Seas surrounded by reefs?

Baby Carriage on a Walking Stick

WHEN little Mary gets tired of walking, her dad can now stop swinging his cane, unlimber an unobtrusive attachment at the end, and like a magician produce a baby carriage, the handle of which is the walking stick itself. To fold it up again, he rolls up the strongly woven canvas snugly around rods that form the framework of the novel go-cart. Reginald Weatherell, British auto racing driver, who invented the ingenious device in his spare moments away from the speedway, believes that he thus has solved one of the problems of parenthood.

He Thumb-Tags Phone Books

BEING that much time could be saved in business offices if telephone directories were thumb-tagged to mark the alphabetical sections, a Londoner put his idea to practical use and is now earning \$5,000 a year. Armed with a concave chisel, hammer, and a small steel stamp for each letter of the alphabet, he makes daily rounds of offices and stores, charging a quarter for each book thumb-tagged.

New Goggles More Comfortable

IN MANY industries the wearing of goggles as a safety measure has been hindered by the workman's prejudice against their inconveniences. A new type, suspended from a helmet of light material, is designed so as to cause no more discomfort than the wearing of an ordinary cap or hat.

Side straps with a row of attachment holes provide adjustment to fit any face, and are so hinged that they may be bent to shape according to individual needs.



He doesn't object to wearing the new goggles, suspended from a cap



Clamping the framework to his cane gives him a sturdy carriage to trundle her home

Ants May Wreck Your Home

IN BLISSFUL ignorance of what is going on beneath us, we sit in our homes while tiny ants are eating away the very foundations. Beams and floors are burrowed into and in time reduced to crumbling dust by the little known termite, the destructive white ant.

In one instance a piano fell through the floor of a house; a sofa fell through the ceiling of another. Damage to private homes from white ants has resulted in losses amounting to hundreds of dollars.

Special building precautions are necessary to combat these white destroyers, says T. E. Snyder, entomologist of the U. S. Department of Agriculture. Complete insulation of all untreated wood from contact with the ground is sufficient, since all the forty-two species of house-wrecking ant are underground borers. Creosote-impregnated wood, and the facing of all subterranean brickwork with concrete, are recommended.

Wing-Shifting Wheel Controls Plane's Balance

CONTRARY to usual airplane design, a strange new biplane minimizes the danger of aerial maulaps by having a staggered construction that places the lower wing some distance behind the upper one. Instead of the ordinary stabilizer that balances the craft in mid-air, the pilot has at his right hand a wheel that shifts the relative positions of the entire wings. Equipped with this extraordinary control, the plane cannot possibly be maneuvered into a dangerous position, according to its designers, so effectively is it balanced in flight.

"Staggered decalage," as the new de-

sign is called, was originated by the aerial research department of the California Institute of Technology, Pasadena, as a result of experiments there by Alfred Merrill, instructor in aerodynamics.



Pilot demonstrating the wing shifting wheel that sets the wings of the airplane at any given angle



Wrench Leaves One Hand Free

THANKS to the sliding sleeve on this wrench, you can reach into an almost inaccessible place, hook the wrench over a nut you cannot even see, slide the jaws tight and twist away—all this being done with one hand.

The sliding sleeve closes the mobile lower jaw when the wrench is hooked over a nut and the sleeve grip is pulled. Adjustment is said to be within a thousandth of an inch. A pipe wrench can also be had with this one-hand adjustment feature.

New Stone Grinds Wood Pulp

IN THE manufacture of edged tools and cutlery the old-fashioned grindstone has long since given way to the modern built-up grinding wheel. Now in the paper industry also, inventors have developed an artificial stone to reduce wood pulp logs to the state necessary for the production of newsprint paper.

The wheel is made of the abrasive silicon carbide. The vitrified segments are attached to an iron spider and are said to offer a more uniform grinding surface than sandstone at the same time producing the long, thin, well-frayed fibers necessary for news-stock.

EXTRAORDINARY ACCURACY in long range gunnery was a feature of recent battle practice at Fort Monroe, Va. A street light was scored on a small moving target a scant fifteen feet long at a distance of more than seven miles. The soldiers were members of Battery E, 8th Coast Artillery.

Telephone Poles on Oregon Lake an Odd Sight

TELPHONE linemen laying a wire across a lake in the Santiam forest, Oregon, resorted to a unique device, illustrated at the left, to carry their lines over the water. They erected the telephone poles on pontoons, which were then anchored into place with huge rocks and wire. The pontoons are made of logs, with crosspieces holding them together. The pole is erected on a crosspiece, braced by stakes nailed to the log ends, and swing insulators are attached to it.

For nearly a quarter of a mile across the lake, the pontoon line carries the telephone wires to connect up with pole lines leading to ranger lookout stations.

Oxygen Hood for the Sick

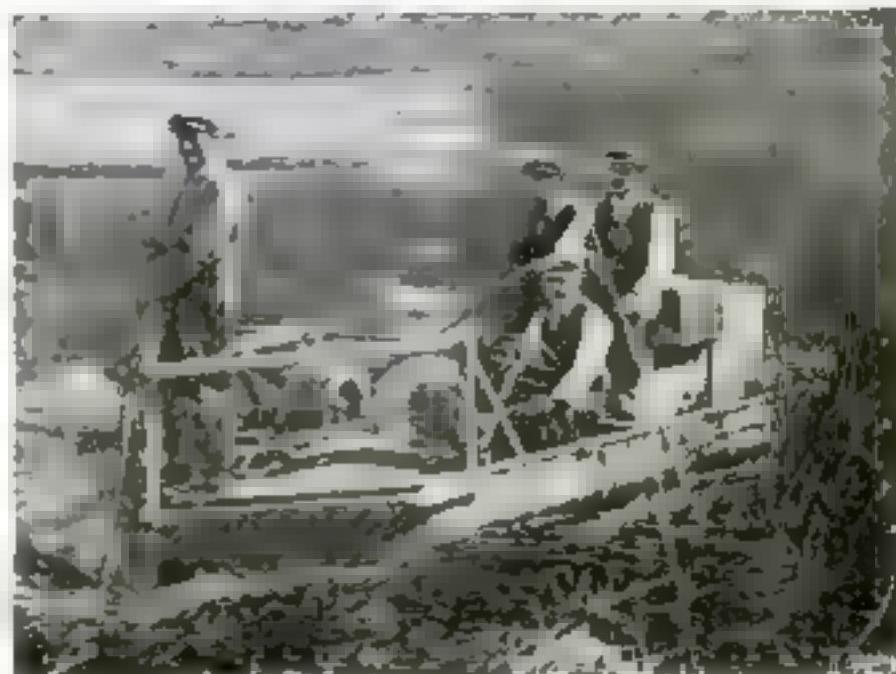
PNEUMONIA sufferers can now have oxygen administered to them in greater degree and with less discomfort, by the use of two new inventions. One is a hood tent, which can be used in homes. The other is an oxygen chamber for use in hospitals. Both, it is said, will probably replace the old funnel method. Dr. Alvan L. Barnach, of New York City, is the inventor.

One of the unique line of telephone poles built on pontoon rafts across an Oregon lake. Huge rocks anchor them firmly in place.

Aquatic Harvester Mows Down Swamp Grass

AHARVESTER that works on water instead of land is the latest weapon in man's war against the mosquito. The odd craft, propelled by a marine engine, pushes its way through swamps where the winged pest is bred, mowing down the tall grass that harbors them as it goes. Each body of water, as soon as cleared, is then stocked with fish that feed on the mosquito larvae.

The French inventor who devised this machine did so in response to an appeal from France's fish industry. A double purpose is served, for not only are mosquitoes eliminated, but valuable fish take

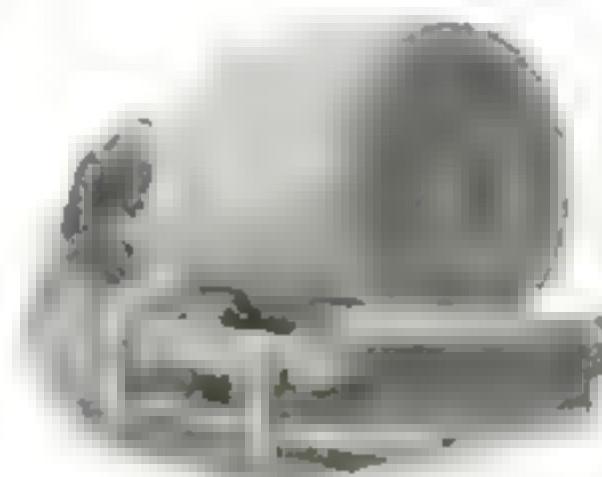


Clearing swamps to France to replace mosquitoes with fish.

their place. Crude methods heretofore used in this work will be replaced by this new invention.

Germans Have Aluminum Trains

ALUMINUM railway trains are being built in Germany. Two, recently completed in Berlin, are constructed entirely of aluminum alloyed with the alkali metal lithium, which weighs one-fifth as much as aluminum and adds tensile strength.



Man-made stone replaces natural sandstone in this grinding wheel for reducing logs to pulp. Longer life is claimed for the artificial stone.

Know Your Car

THIS is the season when the storage battery service stations are busy. A few months of cold weather have placed the average auto storage battery under a heavy load, and starting troubles have begun. Cold motors require plenty of power to crank them, and unless special precautions are taken the charge in the storage battery gets lower and lower until the car refuses to start. The trouble is aggravated by the fact that the car is used so little during the coldest weather, and consequently the battery is not adequately recharged just when recharging is most needed.

To make sure that your car will start promptly in cold weather, follow these suggestions.

1. Increase the charging rate of your generator
2. Inspect and tighten up all wiring connections, particularly the battery terminals.
3. Make sure that the spark plugs are in good condition.
4. Use recommended cold-test oil in the motor
5. Have the transmission refilled with a lighter grade of lubricant.
6. Learn how to operate the choke or to get the motor started as quickly as possible.

**Holds a Whole Meal**

Useful for an auto trip, in fact for any purpose when an entire meal must be kept warm indefinitely, is this generously-proportioned thermal food container illustrated above. It holds several vessels for vegetables and meats

**When the Broom Breaks**

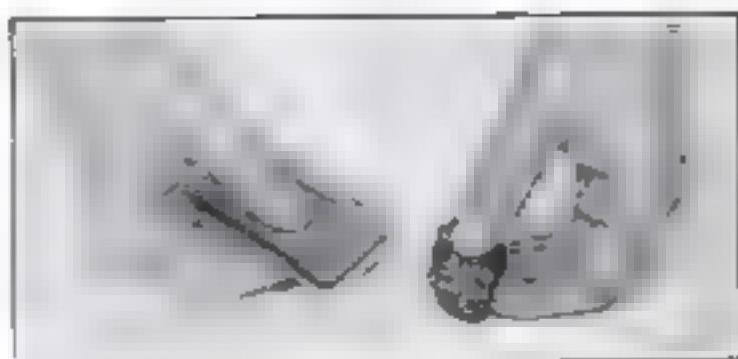
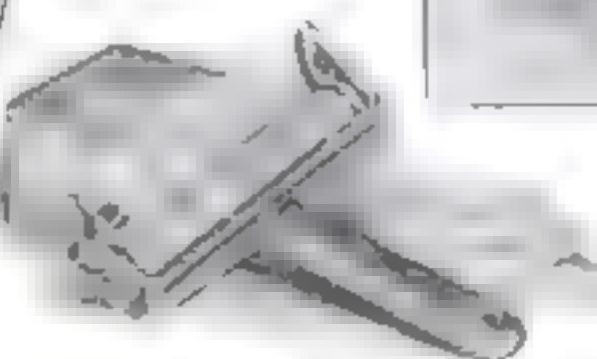
A broken broom handle is quickly mended with this metal holder that clamps the pieces together again. A thumbscrew tightens the joint



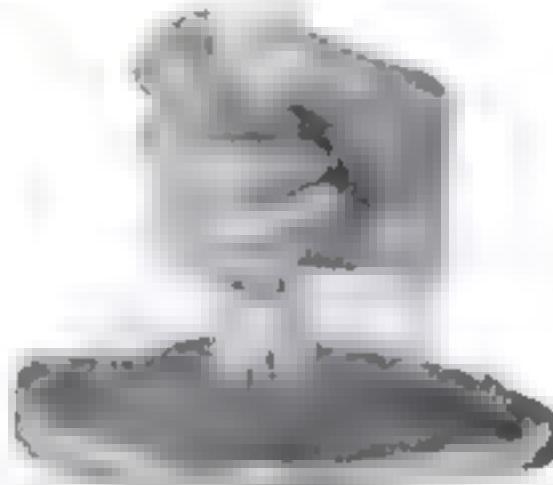
Nineteen New AIDS

Slices Cheese

Cheese slices of a symmetry and uniformity to delight the fastidious hostess' eye are the product of the ingenious slicer below. It is adjustable

**Saves Sticky Fingers**

Dates are pitted quickly and cleanly by the tool above, making easier a job the tedium of which keeps housewives from preparing many delicious dishes

**First Aid for Tough Steak**

A few minutes' work on a tough piece of meat with this little tool will leave it tender and appetizing. Unlike others, it is in one piece and need not be taken apart for cleaning

**Disappearing Clothes Chest**

A slight pull and this cedar wardrobe chest slides out from under the bed. Hung on steel roller bearings, it can be attached without tools to the bottom of any bed

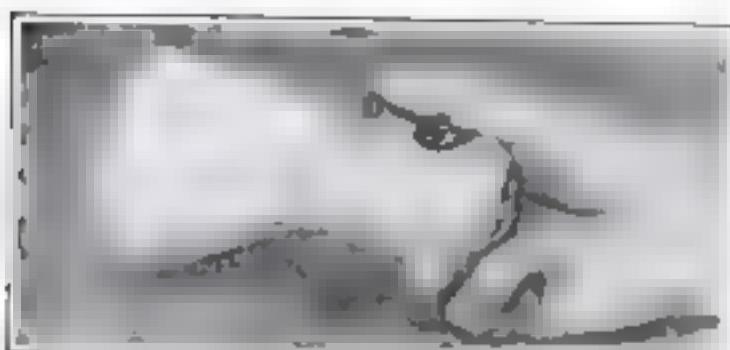
It's a Complete Kitchen!

A marvel of space-saving compactness, this unique buffet cabinet is at once a refrigerator, a range, a pantry and a work table. It even has an opening for a sink. The range may be either gas or electric

Now the Traveling Wardrobe

Any good housewife can think of a dozen uses for a handy, portable, dustproof, mothproof wardrobe (right)—one she can put up anywhere, in the attic or in the summer cottage

for the Homemaker



Brush Holds Its Own Powder

Press the button on this brush and fragrant talcum powder will sift onto the soft bristles from the handle, which is hollow. Thus powder and brush are always together whenever you want to use them.

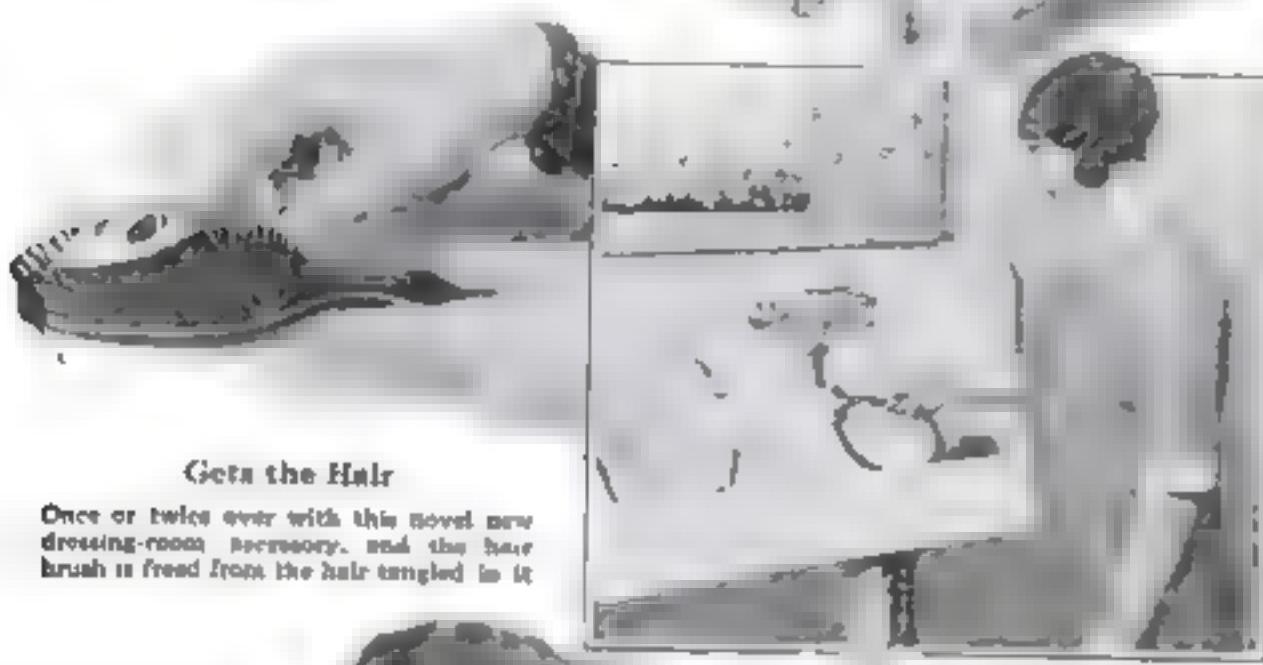
Sharpens Knives

Four little butcher's steels in the knife sharpener below put the same sharp edge on the blade that your butcher uses to prepare your meat. A hard die holds it firm while in use.



All-Around Electric Cooker

Six different heads are available in this electric cooker-oven. It can be used as a broiler, toaster, or as a hot-plate surface cooker.



Gets the Hair

Once or twice over with this novel new dressing-room accessory, and the hair brush is freed from the hair tangled in it.

Those Frozen Milk Bottles

When the north wind howls and the ice gales roar around the milk bottle that the milkman leaves standing no good back porch, this cover tightly encloses it to keep it from freezing.



Dish Pan Built in Sink

This two-compartment sink above saves dishes and drain pins from the kitchen. Dishes are washed in the porcelain bowl in the right-hand compartment, rinsed in the other, scalded with water and left to dry. A faucet faucet serves both of the compartments.



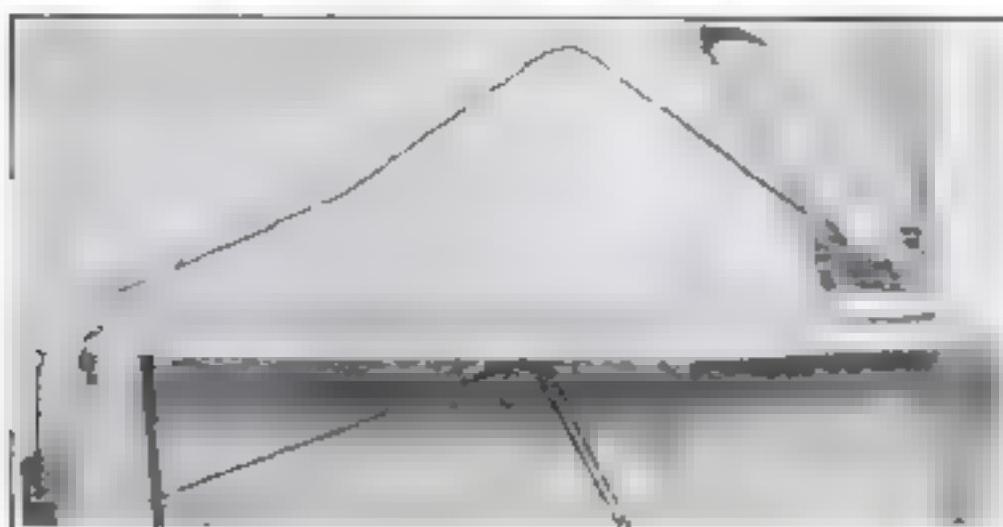
Match Box Becomes an Ash Tray

Where to drop cigarette ashes is no longer a problem for the man carrying this ingenious combination match box and ash tray in his pocket. The ash compartment is built compactly on the side of the metal box.



Novel Electric Toothbrush

The whole family can use it—not the brush, but this minaret motor to which any toothbrush can be attached, as illustrated above. A special motor design gives the brush an up or down motion as desired.

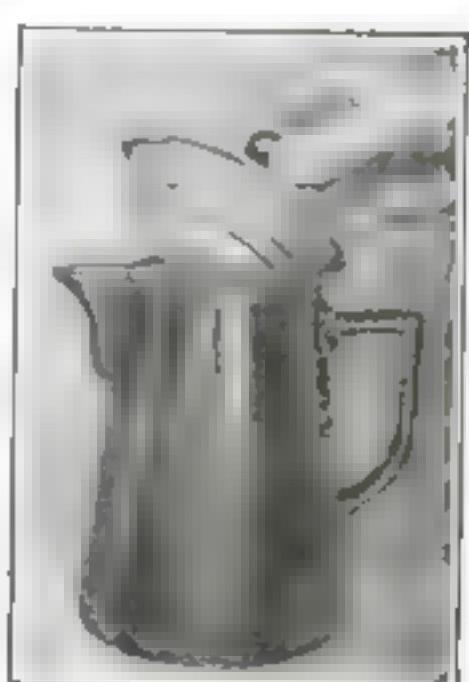


Holds Iron Cord Out of Way

A metal rod that clips to the ironing board holds the electric iron cord out of the way. Left. When not in use it folds down on the board ready for next time.

Multiple Pot Cover

No matter what the size of your pot or pan, a ridged lid right can be had to fit it. Circular rim of different sizes adapt it to mouths of several diameters.



KINKS for the Auto Handyman

Disappearing Luggage Carrier, Dent Remover, Other Ideas

WHILE a wheel puller is the proper tool with which to remove a rear wheel that is tightly jammed on the tapered end of the axle, sometimes you find you must do the job without the necessary special tool. Fig. 1 shows a way to get the wheel off by means of a tire chain and the jack. After the hub cap and locking nut have been removed, the tire chain is looped around a couple of spokes and the end of the jack is placed with the foot against the axle and the elevating step in the loop, so that working the jack lever exerts pressure directly in line with the axle. Make sure that the chain is fastened securely.

Pole Holder for Car Fender

ABOUT the most awkward object to carry in an auto is a long pole. It won't fit inside the body, of course, and when strapped on the side scrapes off the paint. A solution of this problem is to make a pair of brackets as shown in Fig. 3 and clamp them to the fenders. A single bolt will hold each bracket in place, and if felt is glued to the part of the bracket that comes in contact with the fender, there will be no scratching. The brackets can be made of steel of any dimensions, depending on the strength required.

Simple Dent Remover

IT IS possible by the skilful use of a hammer to remove dents in a rim of the type used for straight side tires, but the work is simplified by the use of the tool shown in Fig. 7. A piece of an old spring is first heated to draw the temper, and after a slot has been filed in it, it should be retempered. After hardening, draw the temper to a deep straw color.

To Outwit the Gasoline Thief

THE tourist and auto camper often finds his gas tank mysteriously empty after a night spent in a strange camp or if the car has been stored in a strange garage. Petty thievery of this kind can be stopped by fitting a lock to your gas tank filler cap as shown in Fig. 2.

The hasp and hinge are cut out of heavy sheet iron. The staple is obtainable in a hardware store. Bend the end of the hinge so that

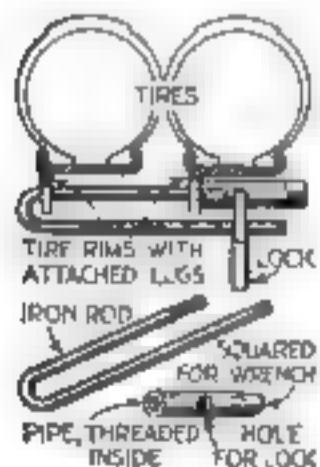


Fig. 6. Two bolts like this, one without the lock, will permit carrying an extra spare tire.



Fig. 1. How to remove a stuck wheel with no tools but chain and jack

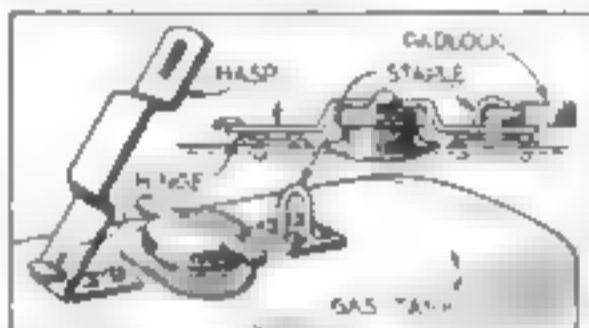


Fig. 2. Locking your gasoline filler cap in this way will prevent those mysterious losses of gasoline that sometimes occur on motor tours

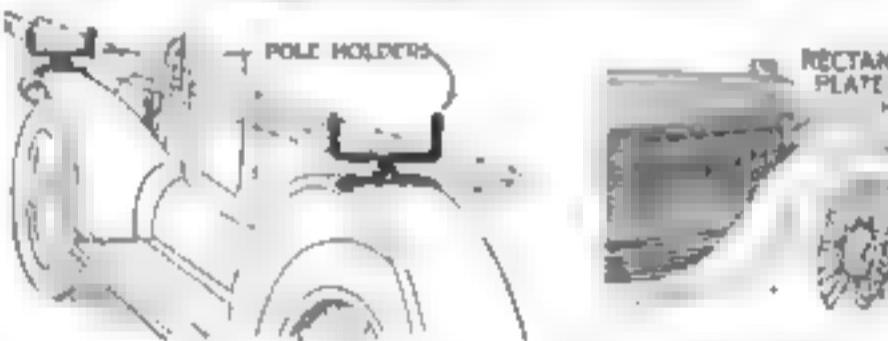


Fig. 3. These special fender pole holders will permit you to carry long poles on your car without scratching the paint

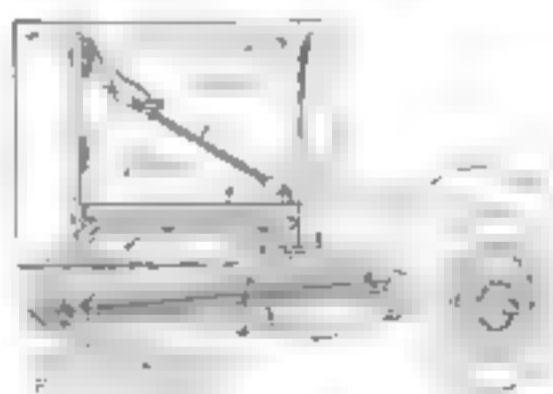


Fig. 5. A folding running-board luggage carrier like this is always handy when you need it, and yet it is out of the way when not in use

Ten Dollars for an Idea!

GEORGE D. HUGO, of Seattle, Wash., wins the \$10 prize this month for his suggestion of the disappearing luggage carrier (Fig. 5). Each month POPULAR SCIENCE MONTHLY awards \$10 in addition to regular space rates to the reader sending in the best idea for motorists. Other published contributions will be paid for at usual rates.

the hasp will clear the nuts. Use long bolts and push them through the holes from the inside of the tank so that you can grasp the ends of the bolts with the pliers while you tighten the nuts. The ends of the bolts can then be cut off and hammered over so that there will be no chance of their loosening up. Use gaskets cut from vulcanized under the bolt heads.

How to Carry an Extra Spare

IF YOUR rims are made with the lugs welded onto them, you can carry an extra spare tire and lock it so it cannot be stolen, by making two bolts as shown in Fig. 6. Only one need be drilled for a padlock, however.

The iron rod should be as large as will pass through the holes in the lugs; and a piece of pipe, threaded, filed and drilled as shown, completes the job. As the bolts hold the extra tire tightly against the one that you regularly carry, there is little chance for chafing unless you are going on a long trip. In that case it would be worth while to slip a short piece of pipe over the bolt that is cut to act as a spacer, so as to hold the tires apart.

Keeps Motor Warm

A RADIATOR cover of the conventional type serves to regulate the amount of air that flows through the radiator while the car is in motion, but it cannot keep the motor warm for very long when the car is standing, owing to loss of heat through the openings in the side of the hood which permit the air to circulate freely. Metal or plywood plates bolted on the inside of the hood as shown in Fig. 4 will stop this waste and also help to keep your feet warm by driving the heated air back through the openings in the floor boards.

Luggage Carrier Folds Out of Way

THIS novel homemade luggage carrier (Fig. 5) is made so that it folds underneath the running board when not in use. Three large sized strap hinges are bent as shown and screwed to the under side of the running board. Wooden or light metal strips are fastened to the movable member of the hinges with short bolts. A leather strap at each end will serve to hold the carrier in the proper position when in use, and a special catch will hold it flat against the bottom of the running board when not wanted.

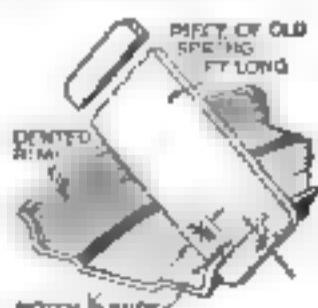


Fig. 7. Dents in your tire rim may be removed with surprising ease with this ingenious tool.

Even New Cars May Have Mysterious Troubles — Can You Tell What's Wrong with Markin's Car?

Here's Another Chance to Test Your Auto Knowledge and Win a Cash Prize

"**T**HREE!" said Mrs. Markin impatiently as she pulled on the emergency brake and shut off the ignition. "Your nasty remarks about women drivers don't apply to me at any rate. I didn't have a single accident all day."

Frank Markin, waiting anxiously for his wife's return with the brand-new car, breathed a sigh of relief as she turned into the driveway beside the hot so.

"Good work, Mary," he admitted. "Are you sure you didn't so much as scratch fenders with anybody?" He walked around the car inspecting it with a critical eye, and then stopped suddenly with his gaze riveted on the gasoline tank. "So you didn't have any accidents?" he exclaimed. "Then what put that big dent in the gas-line tank? You're not going to tell me it dented itself, I hope."

"Oh!" gasped Mary. "I don't do that! I knew I didn't back into anybody, and I'm sure nobody ran it to me. It must have been done while I was in the stores."

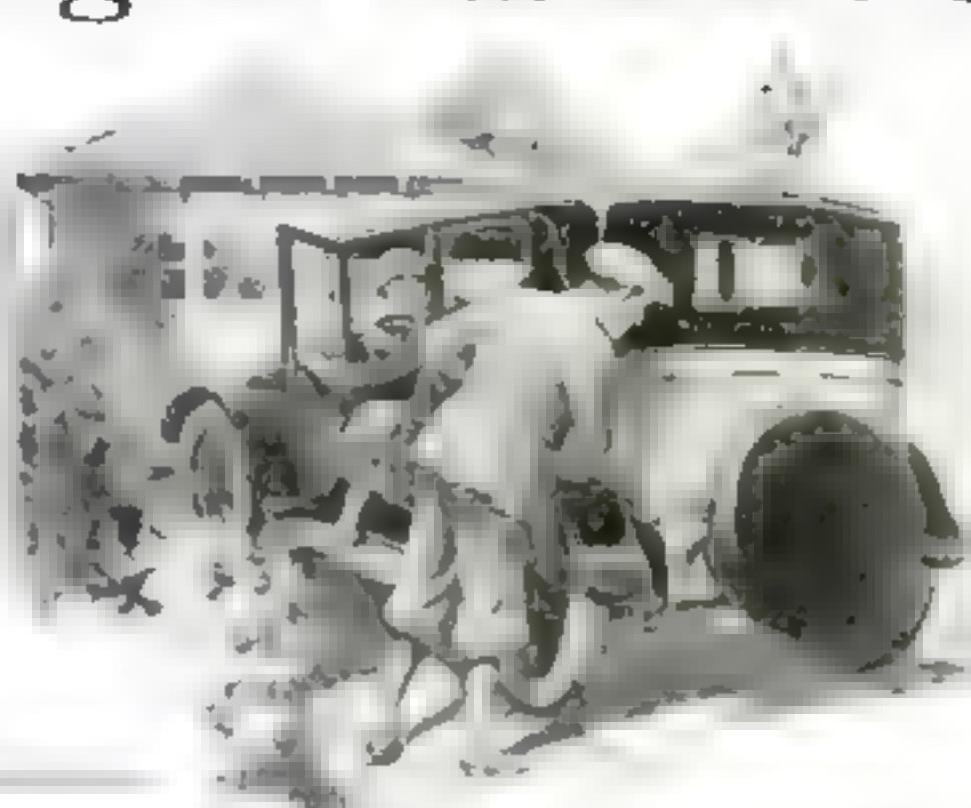
"Hoop!" grunted Markin, obviously puzzled. "I'll be darned if I see how anyone could have dented that tank so badly without damaging the spare tire or knocking bayonet off the tank. And there doesn't seem to be any particular spot on the tank that looks as if it had been hit. I'll drive it down to the service station."

The foreman of the service station, after one glance at the apparently dented tank, inspected it with unusual care. "I know what did that, but it's the first time I've seen it happen in a dog's age," he finally announced. "Let's have a look at the filter cap."

He unscrewed the cap on the gasoline tank and examined it minutely.

"**T**HE vent hole wasn't drilled all the way through," he explained, "and the air couldn't get in to replace the gasoline that was being drawn out by the vacuum in the manifold. There must have been a little leaking in around the threads so that the vacuum created in the gasoline tank was relieved between the filings of the vacuum tank, otherwise the motor would have stalled. As it was, the vacuum ran high enough so that the air pressure outside pushed in the side of the tank. Run her in and we'll fit a new tank. It's our fault, of course."

Markin did as directed, relieved to



There's a Prize Awaiting the Best Answer!

POPULAR SCIENCE MONTHLY will pay \$25 for the best letter explaining the trouble with Markin's car and telling him how to overcome his difficulties. Your letter will be judged solely on how accurately you size up the trouble and suggest the remedy. Letters must reach us before February 28, 1927. Address Automobile Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.

know that it wasn't going to cost him anything. "It wasn't a smash-up after all," he told his wife cheerfully when he reached home.

Their plans for the evening included dinner at their friends, the Barkers. They had promised to be there before seven, and it was nearly six now. So they started out immediately. Markin drove slowly and carefully for five miles, until the mail's pace began to make Mrs. Markin fidgety.

"If you keep poking along like this we'll never get there," she worried.

"**A**LL right then, we won't!" retorted Markin. "I'm not going to run this car by driving it fast. You can bet on that. Lots of cars are spoiled just by driving hard the first few hundred miles. I want you to understand that I know how to handle an automobile," he finished loftily.

But hardly had he finished speaking when the regular explosions of the motor stopped completely and the car coasted to a standstill.

"Now you're giving the motor a rest

I LL DR. dozed off. I see now anyone could have dent that tank as badly without damaging the spare tire or knocking bayonet off the tank," said Markin, puzzled. "I'll drive it down to the service station."

so it won't be overstrained, I suppose." Mrs. Markin couldn't resist remarking as her husband climbed out and tugged the hood.

"I am not," snapped Markin. "It quit on me, and from the sudden way that motor ceased firing it must be a wire that's come loose somewhere. Don't worry, I'll find it in a jiffy."

However, a casual inspection failed to reveal any disconnected wires, so Markin got out the new tool kit and systematically applied the pliers to one connection after another until he had tested them all. Every one appeared to be perfectly tight. "That's funny," he said, "there's nothing wrong with the connections as far as I can see. I wonder if something has happened to the timer? Ah, now I've found it. The spring that holds the contacts together is broken. And I haven't a spare one."

"**S**TANDING there looking gloom won't fix it," suggested Mrs. Markin. "Here, take this safety pin and see if you can't hold it together somehow."

"This is an automobile—not the baby's clothes," growled her husband. "Still I might be able to bend up a spring that will work till I can get a new one. Give it to me and I'll see what I can do."

He worked steadily a few minutes, then: "I've got it!" he exclaimed jubilantly.

The motor started at once when he stepped on the self-starter, and ran smoothly, although it did miss a bit when he speeded up to twenty-five miles an hour.

Auto troubles seem to run in streaks. The Markins must have been in the midst of a

(Continued on page 156)

Amazing New Car Has No Gears



George Constantinesco of London, at the wheel of a car fitted with his remarkable gearless transmission.

A MARVELOUS new type of automobile is now running through the streets of Paris. In appearance it resembles the thousands of small cars that throng the French capital. And yet this car is capable of performing such remarkable feats that it has aroused the intense interest of automotive engineers in all parts of the world.

The car has no transmission of the conventional type. There are no gears and no gear shift lever. Automatically and without attention on the part of the driver, it adjusts itself to the load, so that in any kind of a test or demonstration the driver has nothing to do except steer and press on the throttle with his foot until the desired results are obtained, whether he is towing a five-ton truck up a steep hill or traveling at high speed on an open country road. George Constantinesco, well-known automobile engineer, has perfected in this new gearless car a transmission along radically new lines.

If you ever have tried to push a stalled automobile along a road or to shove a heavy motor boat away from a dock you know how hard it is to get a heavy object into motion and how relatively easy it is to keep it going once you have it started. You have found also that it takes a lot more energy to get it started quickly than if you take your time with the job.

THE ease with which an object can be set in motion if you do the job at slow speed, and the extra effort required when you try to speed up the operation, is taken advantage of in the new gearless automobile. How this is accomplished is shown in the simplified drawing of the most important parts. It shows what happens when the crank is rotated by the engine.

When the motor is started and run slowly and the automobile is stationary, the weight of the car keeps the drive shaft on which the ratchet wheel is mounted from turning, and the motion of the rotating crank is transmitted to the inertia wheel, which consequently oscillates back and forth. When the driver steps on the throttle the motor starts to speed up, and if the inertia wheel weighed practically nothing it would oscillate back and forth at increased speed. But the inertia wheel is made heavy and consequently it offers



A glimpse under the hood. A small two-cylinder, two-cycle motor is used to drive the car. The gearless transmission is built in as part of the crank case in a single unit.



This simplified diagram shows how the gearless transmission passes the power from the motor to the drive shaft in proportion to the motor speed and the load. As the crank runs faster the weight of the inertia wheel resists this speeding up process, and the other end of the differential lever starts to move back and forward, rotating the drive shaft by means of the ratchet wheel.

resistance to being oscillated back and forth with any great amount of speed.

This resistance tends to hold the differential lever attached to it from making the full motion imparted through the connecting rod by the crank and forces the other end of the lever to move back and forth slightly when the increase in speed first starts, and more rapidly as the engine develops more power. Note that the ratchets are so arranged that the ratchet wheel is turned in the same direction both on the forward and the backward motion of the lower end of the link operating through the drive rods. At high speed the inertia wheel remains practically stationary and all of the motion is transmitted directly to the rear wheels.

Ingenious Automatic Power Control Does Away with Nuisance of Shifting

By NEWTON BURKE



Operation of the gearless car is extremely simple. Brake and throttle pedals are the only controls.

The drawing, of course, does not show the parts as they actually are arranged in the automobile. For the sake of clearness the parts have been spread out and magnified. The ratchet wheel, for instance, really consists of a pair of over-running clutches that accomplish the same result without lost motion. Of course this mechanism can drive the car only in the forward direction, and consequently a reverse gear is fitted to facilitate backing the car around in the garage and to make turns on the road.

THE control of the new car is much more simple than any of the standard automobiles. There being no clutch or gear shift lever, the driver does not have to worry about changing speeds. When he wants to stop he takes his foot off the throttle and puts on the brake. The motor slows down and the small amount of energy still being generated is used to rock the inertia wheel back and forth.

When he wants to start he throws off the brake and steps on the throttle and the car starts up without jerk, automatically increasing speed until a balance is obtained between the speed of the car and the amount of power developed by the motor.

Hills present no difficulties. The car simply slows down in proportion to the steepness of the hill. Consequently it will climb any hill as long as the rear wheels can obtain traction. Weird results can be accomplished by the remarkable infinite ratio transmission. If the back wheels are blocked with heavy logs when the car is standing and the driver steps on the throttle, the wheels rise up over the obstacle with a slow and gradual movement that suggests the running and jumping figures shown by a slow motion camera. It also enables a light demonstrator car fitted with a low powered motor to tow a loaded five-ton truck up a steep hill without laboring.

New Detector Tube Brings You More Distant Stations



Putting the new tube through its paces in front of Alexander McNease, who went to eliminate guesswork.

HOW would you like to bring in those weak, hardly recognizable, distant stations six to twelve times louder than you get them now? You can make that amazing improvement in your distance reception just by using one of the new detector tubes now on the market. Excorate and accurate tests recently concluded at the radio laboratory of the Popular Science Institute of Standards show in definite figures the remarkable results obtainable from these new type 200A tubes. The tests now indicate the way to get maximum results with them.

The human ear is notoriously inaccurate in judging volume. Consequently the ear was not used in the tests to determine the relative strength of response obtained with the standard 201A type tube compared with the new 200A type. The strength of response was read in all cases directly from the movements of a hand across the face of a meter.

NO ATTEMPT was made to observe the response of the 201A tube in terms of absolute units. What we wanted to find out was how much better the new 200A tube is than the tube you are now using in the detector socket of your radio receiver. For this reason the strength of the signal input was graduated purposely to make the response curve of the standard tube plot to a straight line, as shown in Fig. 1. This diagram shows exactly what you may expect when you use the new detector tube in place of the tube you now have in your set, assuming that you make no changes of any kind in your set or battery hook-up but simply insert the new tube in place of the old one.

For instance, if you are hearing a weak signal that has a relative

strength of one, you can plug in the new 200A tube and hear it six times as loud.

The great advantage of the new tubes is their ability to bring in weak signals. As the strength of the received signals becomes louder and louder, the curving line representing the response of the new tube approaches the line representing the 201A tube, so that by the time the signal has reached exceptionally loud proportions such as would be received from a near-by powerful station, there is little difference between them.

These tests were made with a standard type of receiving set arranged for use with the 201A tube acting as detector. Still more powerful reception of weak signals will result if you correct the detector grid return wiring so that it goes to the minus instead of the plus side of the filament. Changing the connection in this way practically doubles the volume obtained

A further improvement follows the careful adjustment of the detector plate voltage as shown by the curve of Fig. 2. You will note that beat response is ob-

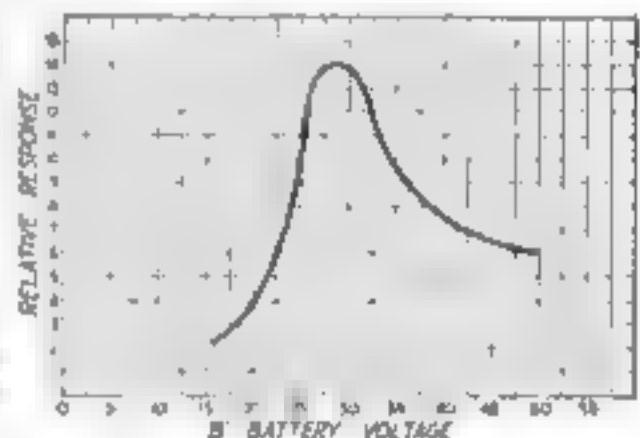


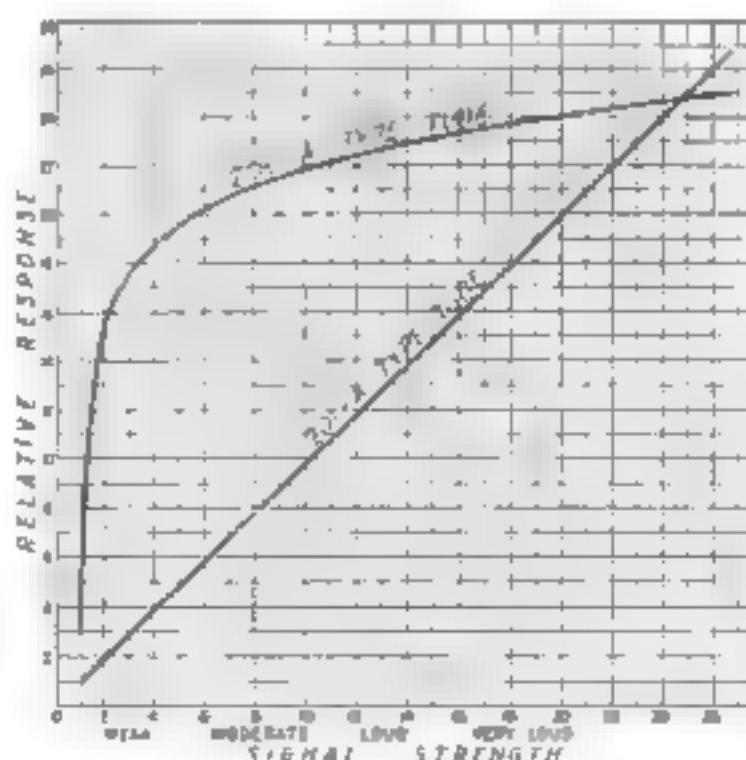
Fig. 2. These plate voltages are figured from minus A. If minus B is connected to plus A in your set, deduct six volts to get equivalent voltages on the plate circuit of the new detector tube.

tained when the detector plate voltage is between twenty-nine and thirty volts.

In actual results the use of the new tube certainly is equivalent to at least one extra stage of radio-frequency amplification. To the city man, surrounded by powerful local stations so that he need not go after distant stations to get good programs, the new tube has particular advantages only if he has some special interest in getting a certain distant station. But to the man who is located where he must bring in distant stations with good volume or else go without adequate radio entertainment, the tube is invaluable.

THE new 200A tubes have one peculiar characteristic. They set up a tremendous hissing noise a few seconds after they are turned on, and this hissing keeps up sometimes for as much as a minute or two. After that the noise die away to a slight hiss that has no effect on the quality of the music. In fact, it can be heard only if you listen carefully when no station is tuned-in or the announcer stops talking for a moment.

No changes are needed in your filament control circuit when you shift to the 200A type tube.



Curve Shows How Tube Excels on Weak Signals

Fig. 1. For reception of local broadcasting where the signal strength is great, the standard 201A tube is usually adequate, but when you want to bring in distant weak signals with loud speaker strength, the new 200A detector tube is far better. On weak signals it is more than equivalent to an extra stage of radio-frequency amplification when used under proper conditions.

Hints for Radio Novices

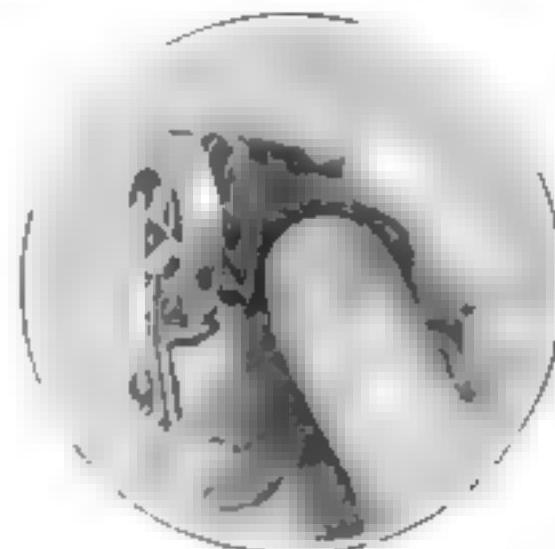
You Can Eliminate Contact Noises

Filing Solder Away Helps—New Control Device—What Size Rheostat?

THE main reason for the introduction of the new X-type sockets, in which the tube prongs are pushed into holes where they make contact with springs pressing against their sides instead of at the tips, is because the tip contact is often the source of scratching and rasping sounds in the loudspeaker. The drop of solder on the end of each prong seems to be responsible for this noise. The solder is necessary, however, as it serves to connect the wires from the tube elements to the prongs.

All noise from this source can be completely eliminated by carefully filing away the solder until enough of the brass prong is exposed to make good contact (see diagram). Watch out that you do not take off so much solder that the connection to the tube element is broken. A study of the shape of the spring in the socket generally will show that it makes contact on a slight angle, and by filing the solder on the same angle you can get down to the brass without removing very much material.

Just why solder should be a poor material for contacts of the pressure type is not quite clear. Apparently the flow of current through the small area of solder that is actually in contact seems to cause a corrosion or chemical change in the solder that is clearly visible as a dark spot on the bright surface even after only



Combined Switch and Rheostat

You can add a volume control to your old set without spoiling the panel arrangement or drilling any new holes, with this device

C-circuit as it would if it were standing idle on the dealer's shelf.

There is a temptation, when you are using one of the power tubes that requires a high C-voltage, to economize by purchasing the smallest size of battery obtainable. These small batteries last only about two to four months even when no current is drawn from them, whereas a medium duty battery will last for more than a year on the C-circuit.

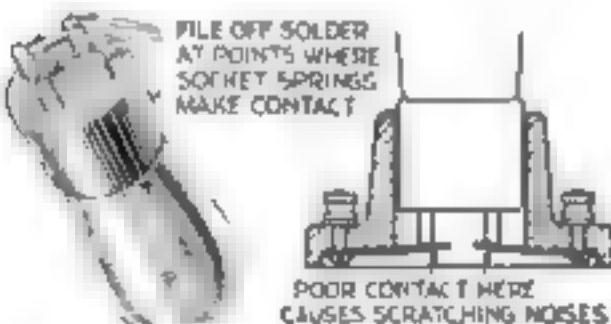
Check Your Storage Battery

THE fact that you have installed a trickle charger does not mean that you can neglect your storage battery completely. Once every month or two, inspect it to see that the water level is not getting too low, and while you are making this inspection you should use the hydrometer to find out if the battery is being kept up to full charge. If the hydrometer shows that the charge is low, increase the rate on the trickle charger or cut down the number of hours the set is in use for a few nights to give the trickle charger a chance to catch up.

New Device Simplifies Control

IN LINE with the desire to make the control of radio sets as simple as possible, there has grown up a need for combination instruments so that two or more different things can be accomplished with the same knob. Twin condensers are one example of this, the combination rheostat and switch illustrated above another.

When the knob is turned all the way to the right, the rheostat itself goes into the off position, and at the same time a separate pair of contacts is opened by means of a fiber cam that revolves with the rheostat arm. These extra contacts can be used to control the other tubes in a radio set when the radio-frequency stages are connected to the rheostat. By



Eliminates Contact Noises

If the sockets in your set are of this type, you can stop the scratchy noises by carefully filing the ends of the tube prongs

a day or two of use. Increasing the pressure of the spring contact helps only a little; the only real cure is getting down to a brass contact.

The same principle applies to the new push type sockets. This means that if you happen to get a tube with solder all over the sides of the prongs, you should polish them off with a piece of sandpaper in order to get noiseless reception.

Large C-Batteries Are Cheaper

SO LITTLE current is used in the C circuit of a radio set that it has almost no effect in determining the life of the battery. In fact, a C-battery usually lasts nearly as long in use in the

this arrangement the one knob serves as a filament switch and volume control.

You can add a volume control to your old radio set by using this instrument without cutting any new holes in the panel. Simply substitute it for the filament switch you now have and wire the rheostat portion of the instrument into the filament circuit of one of the radio-frequency amplifier tubes.

Controlling Two or More Tubes

IT IS entirely practical to control any number of tubes with the same rheostat provided the rheostat is capable of handling the combined current flowing through the tubes and the latter are all rated for the same filament voltage. It makes no difference whether the tubes take the same amount of current or not. One tube may require only $\frac{1}{4}$ ampere while another may use $\frac{1}{2}$ ampere. If both are five-volt tubes, they can be operated in parallel on the same rheostat if the latter will pass $\frac{3}{4}$ of an ampere without undue heating.

There is a simple rule for determining the size rheostat necessary when tubes are operated in parallel. If you know the current resistance of a rheostat for one tube, divide the resistance by the number of tubes you wish to operate in parallel and multiply the current-carrying capacity by the number of tubes.

A B C's of Radio

DISTANCE-GETTING ability and selectivity are two qualities in a radio receiver that have practically nothing to do with tone quality. It is possible to construct a radio set that will be a bear cat for distance, tune with knife-like sharpness, and yet may sound like a five-dollar phonograph.

On the other hand, a set that cannot bring in anything but local stations may give remarkably perfect reproduction of both voice and music. Increasing the range of a radio set and improving its ability to choose between stations cannot improve the quality to be had with a simpler circuit, and there is a chance that the tone quality actually may be impaired in the effort to get extreme selectivity.

The problem confronting the radio manufacturer is to design the radio-frequency amplification end of his set so that it delivers an undistorted signal to the detector tube.

Tone quality can be obtained by the use of a good audio amplifier employing a power tube in the last stage and connected to a high grade loudspeaker.

LOOK!

Run *Your* Radio from your Electric Current

And remember, it makes no difference what kind or what make radio set you have. PHILCO Socket Powers will give you both A and B radio power from your electric light current -dependably and constantly. Here is your opportunity to do away with the ordinary "A" storage battery, dry cell batteries, and "B" batteries.

One switch controls everything. Snap it "ON" and from your house current you get a strong, steady flow of A and B power. Snap it "OFF" and your radio is silent.

No Hum—No Distortion

Philco Socket Powers will give you radio reception without the least hum; without the least distortion. Your electric lighting current will now operate your radio set smoothly and perfectly—any kind or any make of set.

No more recharging to do; no more dry batteries to replace; no more fuss; no more bother, and better still, improved reception.

Yours On Very Easy Payments

You can buy PHILCO AB Socket Powers on *Easy Payment Terms* from any Philco dealer in your town. You merely make a small first payment—balance monthly.

Go to your Electrical Dealer, Department Store, Electric Light Company, Music Dealer or Battery Service Station, tell them you read this advertisement and you want the PHILCO RADIO SOCKET POWER.

Mail This Coupon Now

Visit the Philco dealer, or if you prefer, mail this coupon to us and we will give you the full details direct from the factory. We will send you complete information on our Easy Payment Plan and Trade-In Allowance offer for your old storage battery.

Sign your name and address to this coupon, and mail it to us today. The coupon is not an order. It does not place you under the slightest obligation. It is merely a request for the full details and free illustrated literature describing these famous Philco Socket Powers.

Philadelphia Storage Battery Co.

Philadelphia, Pa.

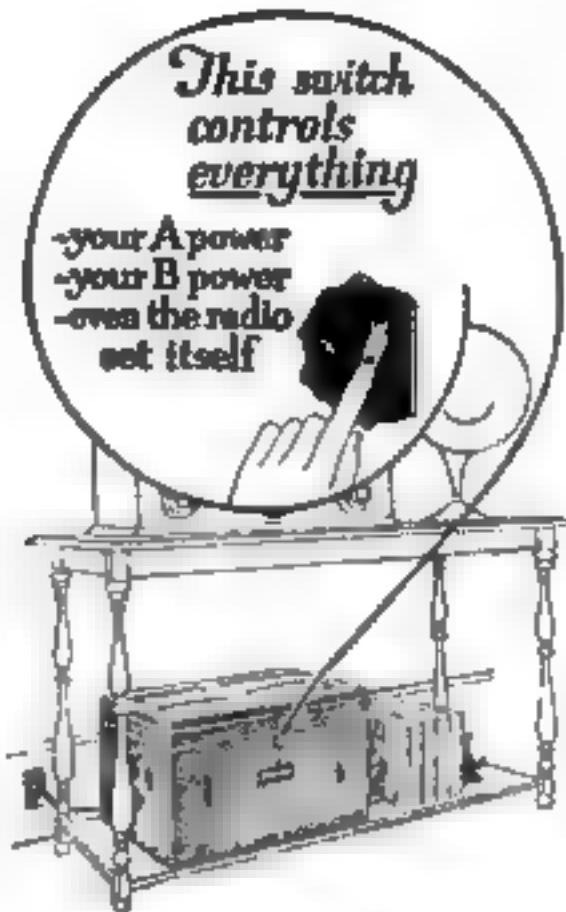


Dept. 1082

PHILCO

Radio "A" and "B"
Socket Power

A. H. & S.



Installation FREE

No matter where you live there is almost sure to be an authorized PHILCO dealer near you who will deliver a brand-new Philco Socket Power to your home on the day and hour you desire. He will connect it to your radio set at no additional cost to you.

The Philco dealer in your community guarantees you complete satisfaction.

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Yes, any one of the many thousands of Philco dealers will make you a very liberal trade-in allowance for your old "A" storage battery on the purchase of a brand-new Philco AB Socket Power.

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SPECIAL COUPON

Philadelphia Storage Battery Co.,
Decarie and C. Street,
Philadelphia, Pa.

Dept. 1082

Gentlemen:

Please send me, without cost, illustrated literature describing the famous Philco A and B Socket Powers. I also desire full details of your Easy Payment Plan and Trade-In Allowance offer. It is understood that this request places me under no obligation.

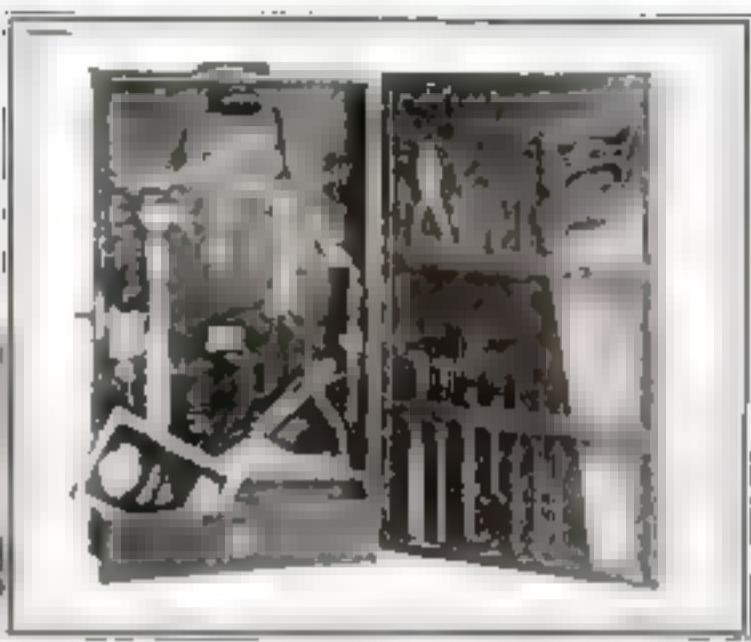
Name _____

Address _____

Name of your radio set _____



Buy separately or in assortments



To bird lovers only!

DO you know that a bird house which is properly made for a bluebird or a swallow will repel a wren or robin? Stanley Plan No. 9-E tells how to make several types of bird houses—each designed to attract a particular species. It will show you how to make homes that will attract your favorite birds and keep the undesirable ones away.

manual training classes. You can buy Stanley Tools separately and so collect your own set. For your convenience in buying there are also complete sets of Stanley Tools in chests at a wide variety of prices from \$15 to \$95. Or there are assortments in strong cardboard boxes containing directions for making your own tool chest. Price \$2.15 to \$20.

Of course you know that good work calls for good tools. The amateur user needs good tools just as much as the professional. Most carpenters use Stanley Tools because their wide experience has taught them that the name Stanley stands for correct design, perfect balance, and great durability. And Stanley Tools are standard equipment in thousands of

Stanley Plan No. 9-E will give you the right start. Your hardware dealer has this plan as well as other Stanley plans for making useful articles, or he can get them for you. Ask him also for Catalogue No. 34-E, which shows the most complete line of wood-working tools on the market. If he cannot supply you write direct to The Stanley Works, New Britain, Conn. The plans cost only 10c each. The catalogue is free.



The best tools are the cheapest to use
Ask your hardware dealer



STANLEY TOOLS



The

The Home Workshop

Arthur Wakeling, Editor

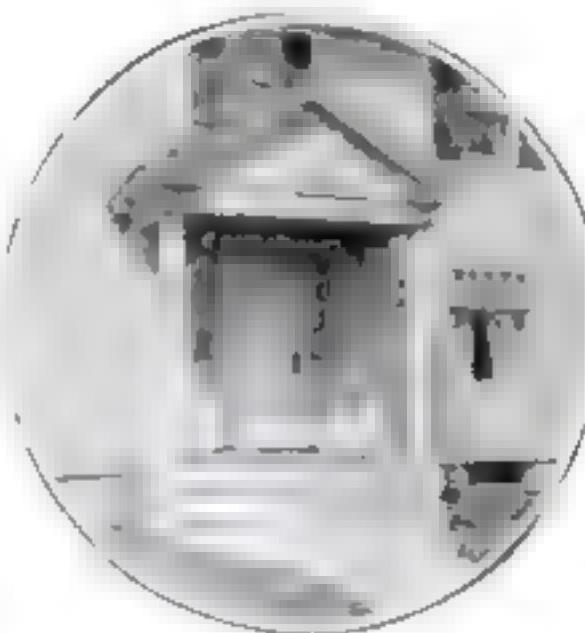
Dividends in Home Building

What You Can Do Yourself to Improve a House - Special Features of Convenience and Beauty That Cost Little to Make

By E. E. Scott

FOR the man with a home workshop, the climax of his peasant labors undoubtedly comes when he builds a home of his own. It is true that he trysts out his hobby for a real joy ride and collects the dividends due on his pine or whitewood "stock." It is then, too, that he finds these dividends amount to something more tangible than the joy of creating and may be cumulative to the extent of as much as ten percent of the cost of his house.

As it is usually necessary for the prospective builder to attend to the everyday business of making a living at his regular vocation, some part of the small work which he would like to do must be delegated to the contractor. Other parts he can do himself, and it will be with no slight amount of a wistful regret that the amateur will discover that his hand-work often surpasses that of the professionals in quality though it may require a little longer to execute. But let us look over the house and endeavor to determine just how much of our own home we can build in our spare time.



The Colonial fan motif which distinguishes this entrance was added by Mr. Scott

The plans, of course, have been drawn personally, or at least, the architect has been asked to include the numerous extra features that go to make the house a home of superior convenience. In my own case I simply could not bring myself to pay a speculative contractor \$1,000 or \$3,000 profit, so drew the plans myself and hired a contractor who took only a percentage on the labor he supplied and gave materials at cost. By this arrangement I not only had a free hand in the direction of the work, but any labor I contributed myself reduced my bill by a corresponding amount.

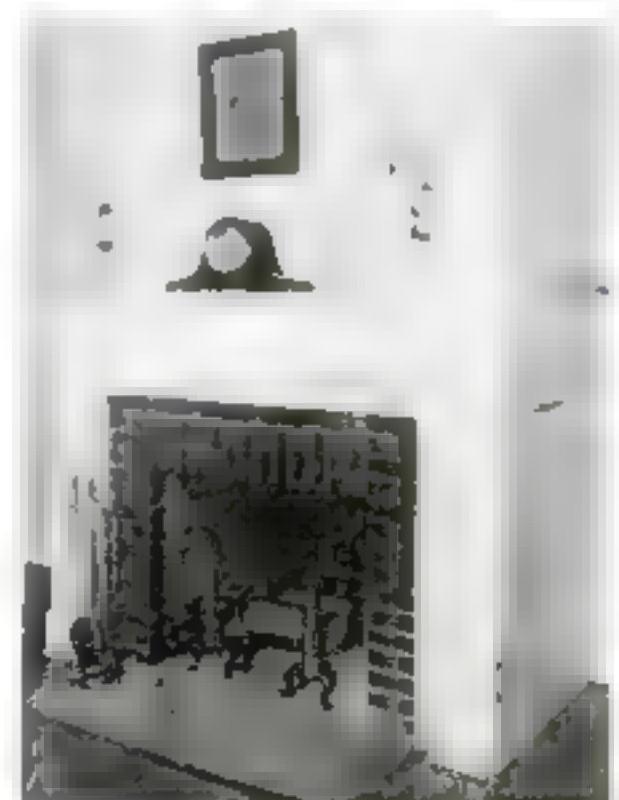
ATTENTION naturally centers first on the kitchen, the workshop of the house, where the opportunities for saving are most stuporous both through efficient arrangement and the amount of cabinet-work required. Patented and stock design kitchen cabinets are all right in their place, but our kitchen is to be fitted with two permanent cabinets, one on each side of the sink. The counter units can be bought fairly cheaply in the unfinished state, but a considerable saving can be made if only one is purchased and a copy made of it.

The cupboards are all simple joinery

and may be subdivided by shelves to suit one's own ideas of convenience. The panelled doors can be bought in almost any desired size at from a dollar to two-fifty each, depending on the size. Since the pantry practically has been eliminated from the modern home, extra cabinets are placed conveniently about the room where dishes and other necessary articles are stored.

The breakfast nook undoubtedly takes first rank as a labor saver in the home, particularly where there are children. Not only breakfast but midday lunch and meals at odd hours can be served quickly in it with a minimum of effort. It also makes an indirect saving in laundry work, as a table cloth is not required. It is well to plan to have the nook large enough to accommodate three persons on each side. The table should be about fifty percent larger than the commercial article and built of 1½-in. white pine. The table as well as the counter tops of the kitchen cabinets are neatly covered with a monochrome linoleum, cemented down, which is not only easily

(continued on page 85)



Mr. Scott saved at least \$115 by building this beautiful mantel and side panels himself



The breakfast nook off the kitchen, which is less cramped than the usual designs



The Constitution capturing the Java. From an aquatint in the Macpherson collection, London

By CAPT. E. ARMITAGE McCANN

WE HAVE now constructed the hull of our model of America's most famous ship, the U. S. Frigate *Constitution*. It stands before us on the beach, a sturdy symbol of that great ship we affectionately call "Old Ironsides," because she was so toughly built that she withstood the onslaughts of her enemies' cannon balls and was never beaten. No wonder she remains with us after 124 years, a glorious monument to the might of the sea power of the United States.

Those who would like to join us in building this model of the *Constitution* will who missed the description of the hull in last month's issue can do so without difficulty by obtaining Home Workshop Blueprints Nos. 57, 58 and 59 (see page 93). These contain full size drawings of the hull, rigging and deck fittings.

All the spars had better be made next, so that the paint and varnish on them will be dry when we come to use them. It is advised that the full size rigging plan on Blueprints Nos. 58 and 59 be used as a guide for making these. If the blueprints are not obtained, be careful to get each spar the right length and thickness as shown in Fig. 3 and the accompanying table. They are made most easily of straight grained dowel sticks of suitable thickness.

The diameters of the masts are given near the heels. Each of them tapers about twenty-five percent to the top; the head of each mast is a shade thicker than the heel of the next above. The foremasts are slightly thinner than the mizzenmasts, and the mizzen (after) masts are nearly a third thinner than the foremasts.

THIS lowermast is white throughout. The other masts (all those lighter up) are white where they are doublled up and varnished elsewhere. A little raw sienna (artist's oil color) may be added to the varnish to darken it prior to applying it, or a dark brown stain may be used and allowed to dry before applying the clear varnish.

The lowermasts are cut off square and filed on the end to make them true, if

necessary. At a position directly under where the tops (marked 1, Fig. 3) will come they are slightly flattened at the sides, to which places the cheeks (supporting brackets) are glued and nailed. These are flat pieces of wood cut to the shape shown on the blueprints and indicated in Fig. 3. They must be firmly fixed as they have to support the tops and all the strain of the rigging above.

The other masts are square at both ends, except the skysail (highest) masts, which come to a fine taper and have a small bead on top of each to represent trucks. They also have a slight collar at the masthead with a small hole underneath. The topmasts (second from the deck) and topgallant masts (third) have a pin or needle driven through them with slightly projecting ends to support the cross-trees (marked 2, Fig. 3); these serve in place of trestle-trees.

The bowsprit and mizzen-mast (see Figs. 1 and 3) are white and the jib boom is white where it doubles with the bowsprit. They taper like the masts, but the flying jib boom (3, Fig. 3) tapers as small as possible at the end.

The diameters of the yards are given at the center; they all taper to half those thicknesses at the ends.

"Old Ironsides" in Miniature



WHEN the hull has been constructed, the next step is to make the spars from birch dowel sticks. An easy way to taper them is to draw them over a cone placed

The taper starts from one third to one half the distance from the middle to the ends. The lower yards have a small staple at the center; they and the topsail yards (the next yards above) have a vertical hole at the yardarms (the extreme ends). They are all varnished to match the masts. The lower yards should have saddles in the center to fit the masts.

The spars may now be laid aside to dry while the other fittings are being made.

The fittings for the masts may be made now, or left to later, as preferred. Their shapes and sizes are shown in Fig. 4. The tops should be made of wood, not more than $\frac{3}{4}$ in. thick, three-ply for preference. The round hole is to take the head of the lowermast and the square one for the heel of the topmast. The rectangular "hopper holes" at the sides are for the rigging to pass through (so named because the hoppers



Fig. 3. Deck view of the model showing position of guns, boats, hatch covers, skylights and various fittings. The hull is 20 in. long

Simple directions for making the spars and fittings of your model of the famous American man-o'-war

her or inexpert sailor could crawl through them). The slot in front is for the yard sling and those at the edges for the top-mast shrouds. The handrails, shaft (at rear) only, may be all of wood or wood with pin posts.

The various holes in the crosstrees and caps (Fig. 4) will expand themselves as the work proceeds. These are best made from celluloid about $\frac{1}{8}$ in. thick, which can be found at a notion counter in the form of comb and various novelties. All these parts should be drilled for their individual masts, so that they fit snugly. They should be white.

The bowsprit is rather more elaborate. Starting at the heel, a groove is made or a cleat nailed on (Figs. 2 and 3) to retain the gunworing (lashing). The next cleat on top is to retain the martingale boom (marked S, Fig. 8); the third cleat, a larger one, is to take the heel of the jib boom (N), and the two outer ones at the sides or "bees" retain the foretop-mast stay (Fig. 1). Below these are fastened at each side a dradeve for the bowsprit shrouds. Underneath, leaving room for the spritsail yard between, come deadeyes for the bobstays. How to make deadeyes will be told in next month's issue.

The dolphin-striker or martingale boom (Fig. 5) is broken and may be made in one piece with the bowsprit cap. Each leg has two holes and a slot at the end. The martingale boom may be of celluloid, but brass is better as it has a considerable strain to carry. It will be white.

NEXT come the numerous guns. The *Constitution* in 1812 carried thirty long twenty-four pounders on the gun deck, twenty-two carriages of thirty-two pounds, two long twenty-four pounders, and one long eighteen pounder on the frigate (top) deck.

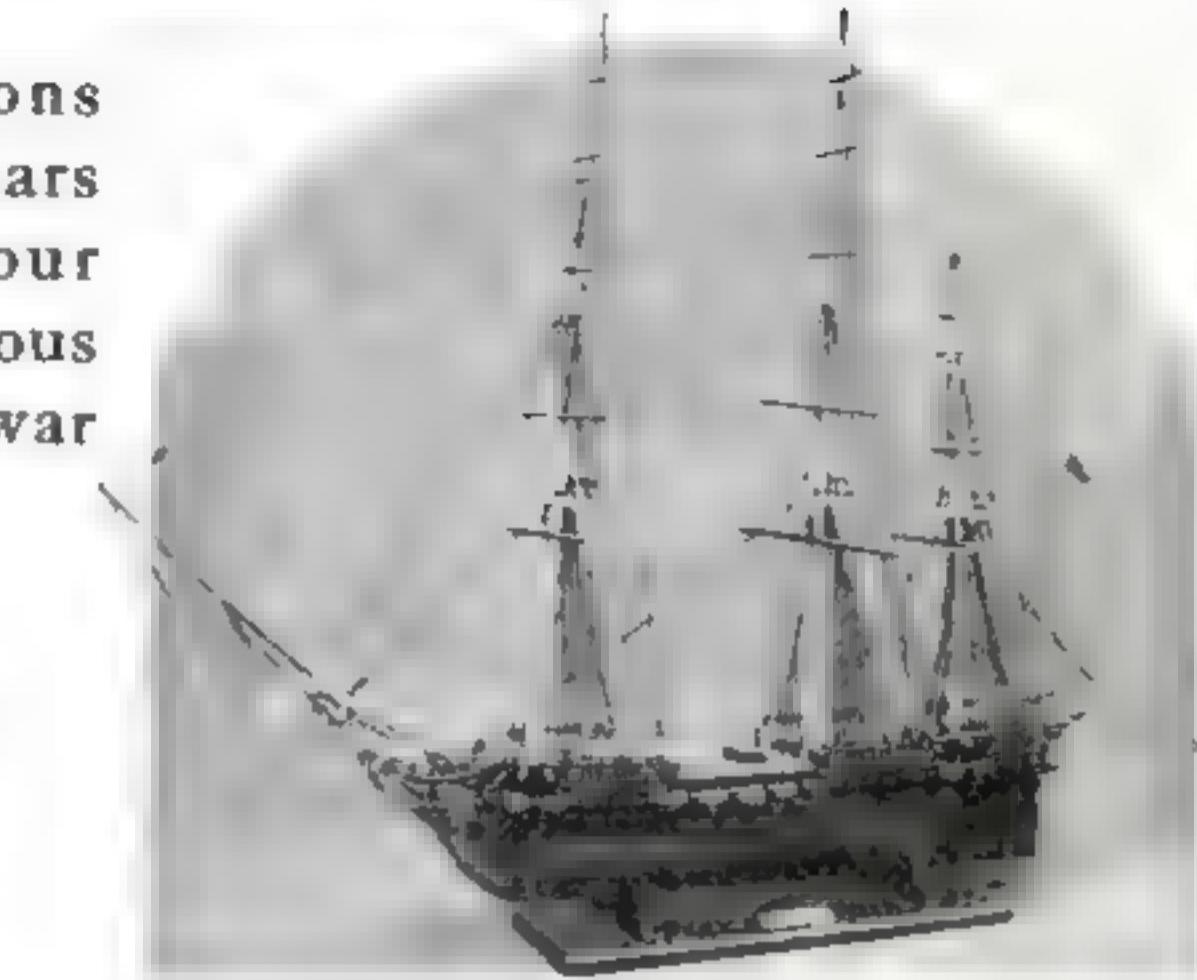


FIG. 1. While this model of the *Frigate Constitution* is as true to scale and authenticity as possible, the construction has been simplified so that a beginner can build it.

These guns may be made from round sticks of wood with a wire driven through for trunnions. They will be 1 in. long over all, $\frac{3}{4}$ in. in diameter at the large end and a bare $\frac{1}{2}$ in. at the thinnest part. There are, however, so many of them, that I found it easier to shape one carefully, make a plaster of Paris mold, and in it to cast the others in lead.

THREE lower deck guns may be made in the same way, but without the butt ends. $\frac{5}{8}$ in. will be long enough for them. All the guns may be black or bronze color, with black spots at the ends (Fig. 2).

The gun carriages (Fig. 5) are cut with fret saw and penknife from a rectangular stick of soft wood. They are stained dark brown, and the guns are stapled to them by the trunnions. They will be glued to the deck later.

The life rails (Figs. 2 and 5) are made from hardwood, with uprights $\frac{1}{4}$ in. square and rails $\frac{1}{4}$ by $\frac{1}{8}$ in. The posts are slightly pointed and driven into square holes in the deck and glued. The rails are nailed to these with pin points, as well as being glued. Pin points passing upright through the rails represent the bracing pins.

There also should be a small pin rail with two pins each inside the bulwark between the gunports at a point opposite the main rigging; these are glued and nailed to the bulwarks (see the deck plan, Blueprint No. 57).

The channels (Figs. 2 and 5), to spread the rigging, have their upper edges coinciding with the edge of the deck although

the after ones are a shade higher than that. They are of semihard wood $\frac{3}{8}$ in. thick and $\frac{3}{4}$ in. wide. The forward ones will require curving slightly to the hull lines. They must be glued and nailed firmly in position.

Two staples will be needed in the deck right in the bow on either side of the heel of the bowsprit (Fig. 2); two just forward of the first mud, one on either side, close to the bulwarks, between gunports 1 and 2, 3 and 4, and 9 and 10, counting from forward; these are for the Beaufort shrouds and must be firm.

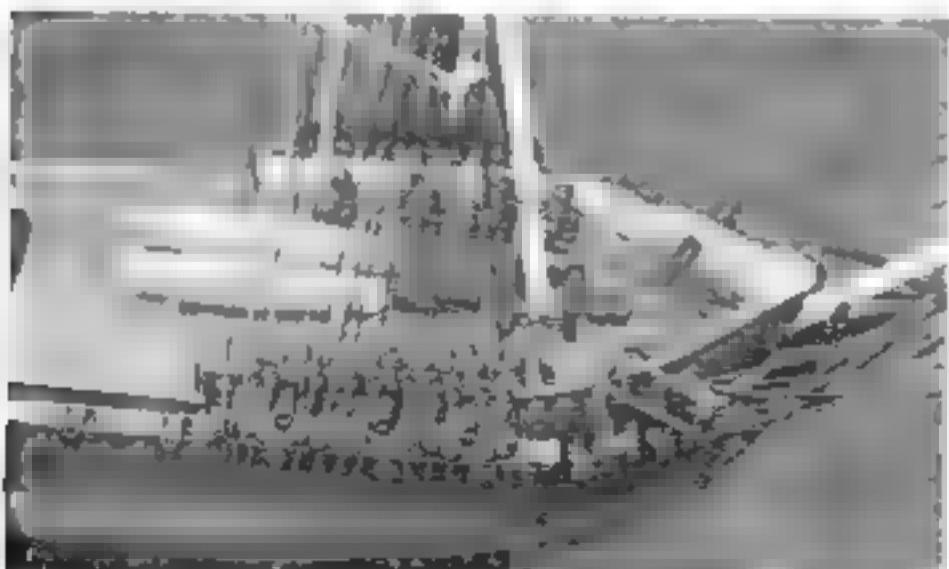
Cleats will be wanted in the bulwark just forward of the first gunport, between the last two, and on the after bulwarks at the sides. They can be made of wood or celluloid, but two leadless pins driven in across each other will serve the purpose.

Spars from which the quarter boat would hang project from the stern (Fig. 2). They are $\frac{3}{4}$ in. square wood, slightly curved and nailed inside the bulwark. $\frac{1}{8}$ in. a board and $\frac{1}{4}$ in. outward. They are painted black.

The hatches (Figs. 2 and 6) are of soft wood $\frac{1}{8}$ in. high and of the various sizes shown. The tops are in the form of gratings, which may be thin strips of wood, or simulated by punching holes with a square pointed nail. The sides will be black and the gratings dark brown. The skylights on half of two of them are small blocks glued on top. The glass effect is obtained with dark blue paint diagonally streaked with white, which is blended into the blue.

ON EITHER side of the capstan the hatches should be a scant $\frac{1}{8}$ in. high. It seems a foolish place to have them anyhow, because the men going round the capstan would have to climb over them as they heaved. Presumably they were for the ropes to be carried up and down.

The steering gear (Fig. 6) consists of two wheels with a wooden barrel between, supported by an upright at either end. The wheels, (Continued on page 90)



Full size drawings of all parts are contained in our Blueprints Nos. 57-58 and 59 (see page 91), which you will find a great aid in building the model.

What Radio Kit Sets Offer You



A typical "essential parts" kit set. It will give you three stages of tuned radio frequency amplification with only two tuning controls. All parts needed for the tuned circuits are included in it.

YOU can build a mighty fine radio set these days, even if you know nothing whatever about radio. Standardized radio kit sets have made this possible. In fact, the illustrations on these pages will give you an idea of the wide variety of kits which are now being manufactured to help you turn out a radio set that will give you highly satisfactory results and also rival the best commercial sets for finished appearance.

The Popular Science Institute of Standards has approved a number of kits for home building, after determining the quality of the parts that go to make up each kit, as well as inspecting them from the viewpoint of the man who is going to be up against the job of putting them together to get the set into operation. This means that to pass the Institute tests, the outfit must be practical and efficient, the parts must be designed to work well with each other, and the instructions accompanying the kit must be clear and definite.

To meet your individual requirements, various types of radio kit sets are available. The so-called "essential parts kit" is a popular type and usually consists of all of the most important parts that make up the electrical circuit. The manufacturers of such kits always supply a list of the rest of the material needed to make up a complete receiver. This type of kit is especially desirable if you already have done some radio work and you have a number of parts on hand that you wish to use. It also appeals to the more experienced radio fan who wants to exercise his own discretion in buying the rest of the apparatus.

In most cases, you can obtain drilled and engraved panels suitable for use with the variable condensers and other controls furnished with a kit of essential parts.

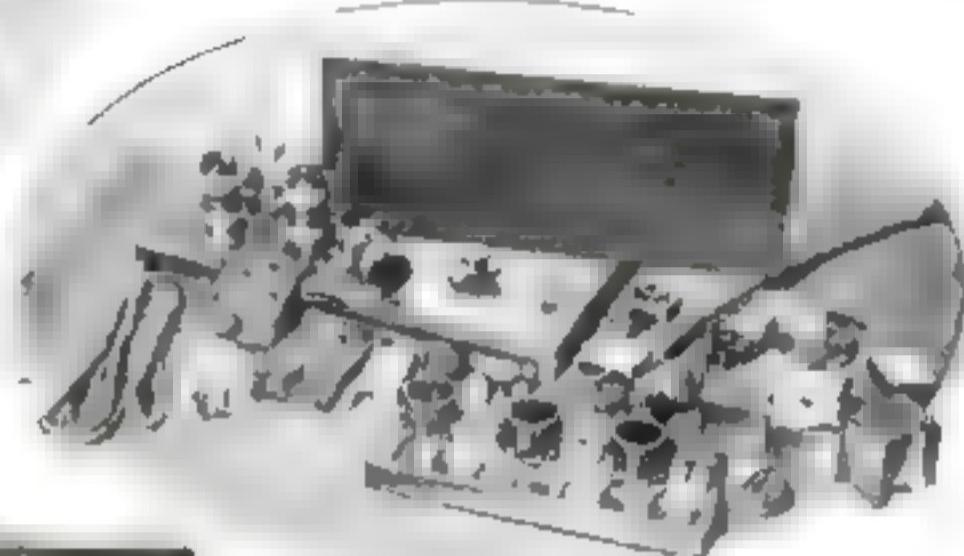
If you are a beginner at the radio game you may want to buy a radio kit that will



Mechanical labor is avoided by the use of a kit that includes a drilled panel, subpanel, knocked down aluminum stage shields and all the necessary hardware

How Any Amateur Can Build a Good Receiver Cheaply and Easily from Tested Parts

By ALFRED P. LANE



Above is a five tube kit set that is complete down to the last screw. It features resistance coupled audio amplification for tone quality on the loudspeaker

include every single part down to the last screw and nut. Complete kits of this type also are available.

Cabinets ordinarily are not supplied with radio kit sets. While you and your neighbor may agree on the electrical and mechanical features of a receiver, each of you will have his own ideas about the proper way to house it. Your neighbor may want nothing more than a cheap wooden box to protect it and keep it from getting dirty. You may prefer to build or buy a more elaborate job of cabinetwork or a console type radio table fitted with a compartment for the batteries and perhaps a built-in loudspeaker. However, radio kits are being designed in standard sizes to fit into the front of the factory built radio cabinets

and consoles that are now available. Kit sets are constructed according to latest engineering practice and embody most of the modern ideas for better reception found in the finest commercial receivers. You can get an essential parts kit for a circuit employing six tubes with several stages of radio-frequency amplification tuned by coils of the closed field type and twin condensers, so that there are but two tuning controls. Again, a five tube outfit has coil shielding with the hot word in variable primary coupling for each tuned radio-frequency stage. Rotating the condenser shaft automatically changes the relation of the coils to give the maximum energy transfer on any wavelength.

STILL another kit features complete shielding with an all-metal chassis including a metal front panel. Two-dial tuning is obtained on this set by an ingenious lever arrangement that couples the condenser shafts.

Resistance-coupled audio amplification is an important feature in a kit that also employs two stages of tuned radio-frequency amplification. This particular kit includes a drilled, engraved panel and a special wooden baseboard supported by wooden runners at each end to allow space underneath for most of the wiring.

All modern radio kit sets are designed to take advantage of the possibilities of the latest types of power tubes so that you can get plenty of volume without distortion.

The great advantage of kit construction, as far as the inexperienced amateur radio fan is concerned, is that the parts are designed to work with each other. You do not have



To Help You Choose

A SPECIAL list of approved radio kit sets has been prepared by the Popular Science Institute of Standards. This list and a brief description of the important features of each kit will help you choose the type of outfit best suited to your needs. Address your requests to Radio Editor, Popular Science Monthly, 250 Fourth Ave., New York City.

If you are a beginner at the radio game you may want to buy a radio kit that will

(continued on page 72)



Look for this *New* Electric Drill Display at your Hardware Store

You can expect good service and long service from this Millers Falls Electric Drill. Read the specifications below. Then look for the display and ask for a demonstration. Leading hardware stores throughout the country have this drill in stock.

You will find that Millers Falls standards of quality and performance are lived up to in this new tool. It is sturdy, well balanced, easy to use, and easy to take care of. Sixty years of tool making are behind it, and years of use are built into it.

More efficient work in shop or garage result from the use of this Millers Falls Electric Drill. It is unexcelled for amateur work. We welcome the most thorough test.

MILLERS FALLS COMPANY • MILLERS FALLS, MASS.
NEW YORK, 28 WARREN STREET • CHICAGO, 9 SOUTH CLINTON STREET



Specifications

Portable

Electric Drill No. 414

MOTOR Universal—operates on D. C. or on A. C. up to 60 cycles. **SPEED** No load 1800 RPM ± 2 Amps. **CAPACITY** 1/4 in. dia. steel, 1/8 in. or cast iron, 1/4 in. dia. wood.

Furnished for 110 or 220 volts.

Jacobs heavy duty chuck.

Heat treated alloy steel gears.

Ball thrust bearing on spindle.

Armature mounted on high grade ball bearings.

Automatic switch mounted on handle.

Armed attachment plug.

Aluminum housing efficiently ventilated.

Pig-tail brushes (not usually found in drills of this size). Easily replaced from outside without taking tool apart.

Grease lubrication throughout.

Finest best quality rubber covered cord furnished.

Spindle offset for close boring— $1\frac{1}{2}$ in. front

extreme of handle.

Weight 5½ lbs. net.

Overall length 22 in.

Packed one in a heavy corrugated box.

PRICE • 110 Volt, \$30.00.

How to SELECT and BUILD a Radio Kit Set

(Continued from page 70)

to find out what capacity condensers are needed with the coils you have already purchased or whether a particular type of amplifier will give quality reproduction with the tuning circuits you have worked out.

TROUBLES with squealing and oscillations caused by improper placing or adjusting of coils will not bother you if you buy either an essential parts lot or a complete kit. The manufacturer has done away with all these difficulties. This is a point of particular importance in attempts to build a radio set. Shielding a coil changes its effective inductance, and the number of turns of wire in the coil must be adjusted to compensate for this effect. Otherwise you will find that the desired range of wave lengths cannot be covered. The size of the shield, the diameter and length of the coil, and the spacing around it influence these calculations. Manufacturers of kits that employ shielding take all these factors into account in building the various pieces of apparatus.

Your success in assembling any good radio kit set will not depend on your theoretical or practical knowledge of radio matters. You can get away with it even if you don't know a vacuum tube from a storage battery. It is absolutely essential, however, that you go at the work with a fixed determination to follow the diagrams and printed instructions to the letter.

No matter how anxious you are to get started on the actual work of assembling and wiring, don't let your enthusiasm get the best of you. Before you do a stroke of work, sit down with the instruction book and the parts of the kit, and go over every detail until you are familiar with it. Make sure that you have positively identified the terminals of the various instruments with the references to them in the instructions and wiring diagrams.

Perhaps the greatest advantage of building a radio set from a kit of parts is the fact that the manufacturer has carefully matched them so that they will work with each other to give correct results. Consequently, unless you are an



Study the Instruction Book!

Detailed wiring diagrams and clear simple instructions for assembling the apparatus are necessary parts of a good kit set

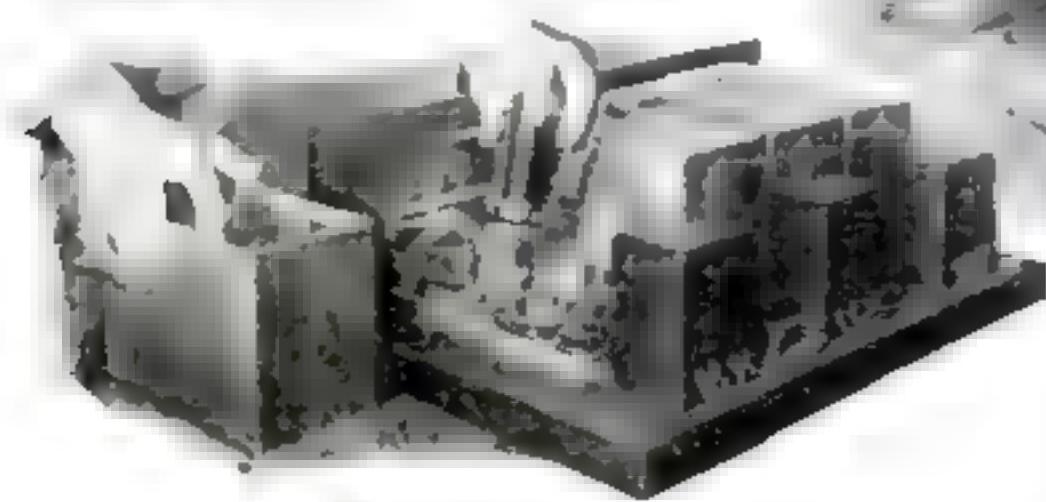
expert, it is a mighty good idea to follow the manufacturer's directions, both as to the parts to use and their placement in the receiver, exactly as specified. In many cases other parts may be substituted with equally good results, but if you are a beginner you will have no means of knowing what liberties you can take with the instructions without getting into trouble.

Aside from troubles with electrically mismatched parts you may run into mechanical difficulties. For instance, you might decide to use a different type of variable condenser and then find that the dimensions of the condenser you had bought were such that it would not fit into the space provided for it in the layout.

THREE amount of work and the tools needed to build a receiver from a kit set will depend on the type of kit, and on what is included in it. If, for instance, it is a complete kit with a drilled front panel, a base or subpanel that also is drilled, and all the necessary brackets and other hardware, you will have no real construction work to do. Your problem will amount to nothing more than bolting and screwing the parts into place and doing the



The tuning unit at right, from a popular kit set uses a unique action to vary the coupling as the condenser plates are moved



A metal panel and baseboard with wiring concealed underneath, as well as complete shielding, interchangeable tuning coils, and simplified tuning, are featured in the kit set illustrated above. Any amateur can build it



Closed field radio-frequency transformers tuned by two condensers fitted with small tuning condensers make high amplification and sharp tuning easy with the essential parts of kit

necessary wiring. For such work you will need wire-cutting pliers preferably of rather small size, a screwdriver and, in most cases, a soldering iron, soldering paste and solder.

Don't be afraid to tackle soldering. Anyone can master it in a half hour's practice on some short pieces of wire. The secret of good soldering is to have the iron hot enough so that the solder actually flows into the joint. Most of the trouble is caused by removing the iron before the metal parts to be joined have become warm enough.

From an electrical point of view there is little choice between a soldered joint and a connection to a binding post provided that both are properly made. As far as speed in wiring is concerned, soldering the joints is just about as fast as bending up loops to be clamped under binding posts, especially as it takes practice to cut off a piece of wire the right length so that when you bend one end of it into a loop the wire will fit where it belongs.

IF YOU purchase a kit without a drilled panel, you will need to add a small hand drill to the tools listed above.

Before you start assembling the parts of the kit on the panel and baseboard or sub-base, make sure that the parts fit together and into the cabinet. Then proceed with the assembly and start in on the wiring. It is a good plan to cross off each wire on the diagram as soon as you get it properly fixed in the receiver. This will help you to check the wiring and make sure that no connections are overlooked.

If you like to build things yourself, the radio kit set offers you an opportunity to construct a high class receiver with most of the chances for errors eliminated before you start.

Factory built radio cabinets of almost every possible style are now available so that you need not worry about this important part of your outfit. There are plain cabinets in various kinds of wood costing from five to ten or fifteen dollars and there are more elaborate cabinets with inlaying, carving and so on. Console type tables with a space for the radio set in the upper compartment and room

for the batteries in the lower section are very popular. These can be obtained with built-in loudspeakers either with or without a loudspeaker unit.

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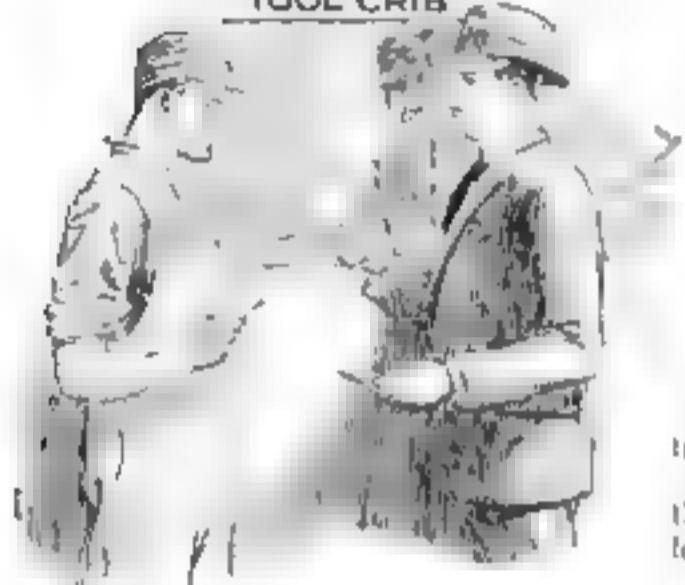
Better Shop Methods

How Expert Mechanics Save Time and Labor



Tricks in TAPER REAMING

TOOL CRIB



Grimes selected a taper reamer with a much greater twist than usual for Harvey to use.

"HANG it all! That's the second taper reamer I've broken this morning," exclaimed young Harvey Smith angrily, as he took the broken tool out of the chuck and marched down the aisle to the tool crib to get another.

As he stood waiting at the window a familiar voice greeted him with "Hard luck, Harvey—break a reamer?" Mr. Grimes, the efficiency engineer, was the speaker.

"Yes, sir. That makes two already today. It's a mean little job—come over and look at it will you?" Harvey responded as he picked up the new reamer. They both walked up the shop to Harvey's machine.

"Here are a couple of boxes of shafts and collars (A and B, Fig. 1)," explained the young machinist. "I have to drill and ream the hole for the taper pin (C) and assemble the pin. Every little while the reamer seems to catch in the work and pull in. The next thing—snap! it breaks, no matter how carefully I feed it."

GRIMES looked at the work for a moment and then said, "Well, Harvey, a reamer like you are using (D, Fig. 1) is best suited for hand reaming. A spiral fluted reamer (E) would not cause you so much trouble, as the spiral, being cut left-hand, tends to keep the reamer from pulling into the work. I am referring to the regulation taper reamer particularly suitable for machine reaming. There is still another form (F) made with a much greater twist. It is still better for steel work, indeed, it is a special form that is exceptionally good. Let's try the tool crib and see what Charlie has."

How to Choose the Right Type of Tool—Roughing and Finishing Reamers—Lubrication

By ALBERT A. DOWD, Consulting Engineer

They found what they wanted—a reamer like F.

"I don't know why Charlie didn't give me one of these in the first place," Harvey commented, as they returned. "I can see by looking at it that I won't have much more trouble with this job."

He slipped it into place and tightened the chuck. Grimes watched him for a few minutes and then remarked, "You

have used, but I can see it easily now."

"Taper holes are always troublesome," continued Grimes. "I saw a pile of small castings over there by the turret lathe a day or two ago and a blueprint showing that they are to be turned, faced, bored and reamed to a taper plug gage. Are you going to do that job, Harvey?"

"Yes, just as soon as the rest of the castings come in. I shall probably go at it in a day or so."

THE noon whistle blew at that moment and Harvey and Grimes walked over to the turret lathe to have a look at the castings. Special chuck jaws indicated at B, Fig. 2, were to be used to hold the casting so that it could be turned, faced, bored and reamed at the same setting.

"How are you going to put in the taper hole?" asked Grimes.

"Oh, I'll use a core drill (C, Fig. 2) and follow it with roughing and finishing taper reamers (D)." Harvey motioned toward the tools, which were lying on the bench.

"Must the hole be concentric with the outside of the work?" inquired the engineer.

"Why, certainly."

"Well, you won't get it that way, my boy. If the cored hole were absolutely true you wouldn't have much trouble, but both core drill (Continued on page 116)

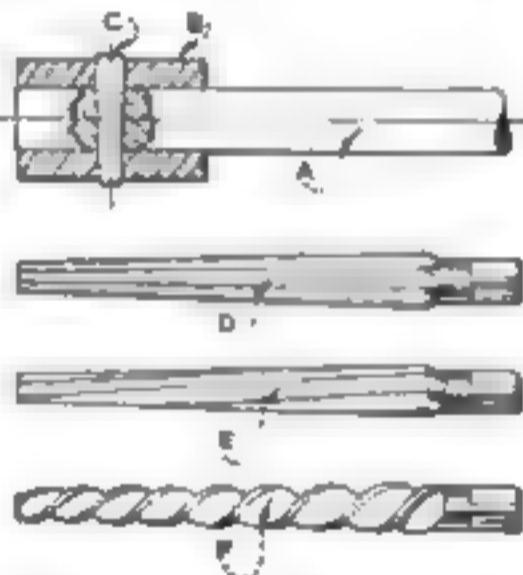


Fig. 1. If you had to ream the hole for the taper pin C, which reamer would you choose?

can see now, Harvey, how important it is to pick the right kind of reamer for a job. If you had used the right reamer to start with, you would be almost through with the work now and wouldn't have broken any reamers."

"You're right," acknowledged Harvey. "I didn't realize just what I should

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, to be found on pages 118 to 123.

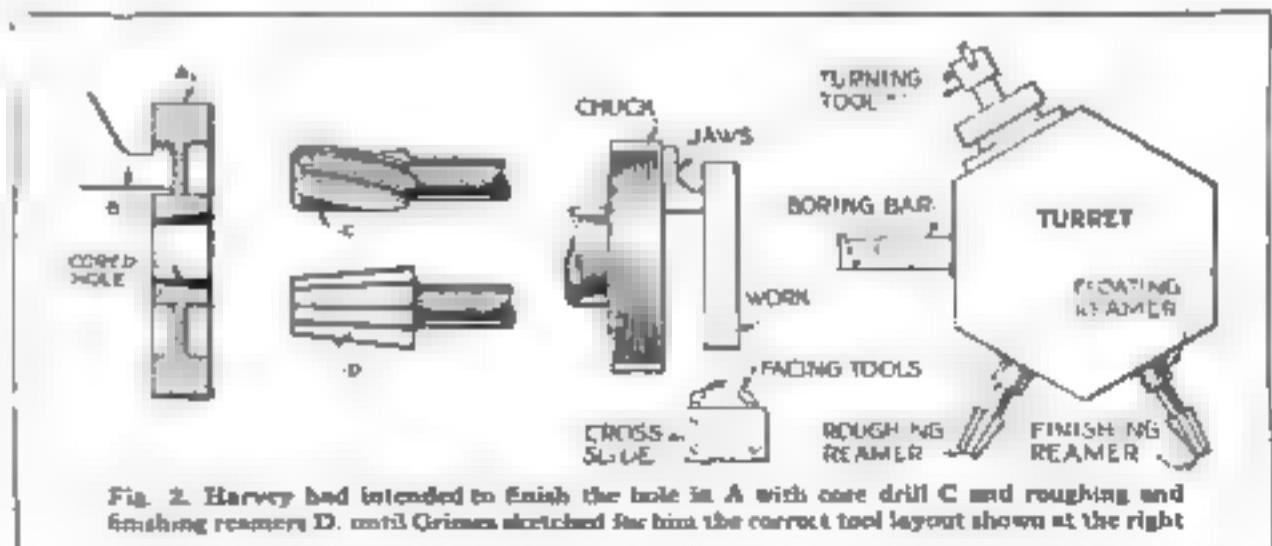


Fig. 2. Harvey had intended to finish the hole in A with core drill C and roughing and finishing reamers D, until Grimes sketched for him the correct tool layout shown at the right.

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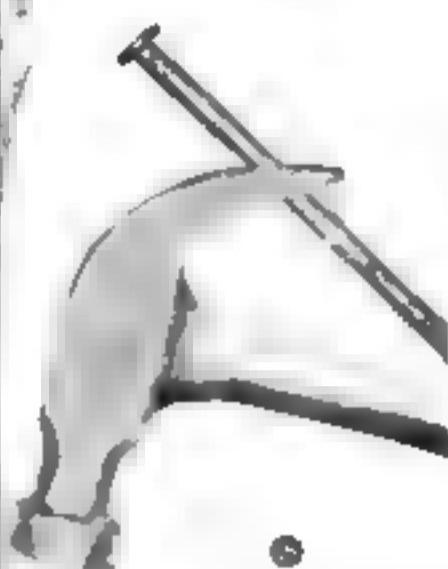


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Hacksaw Frame No. 169. Combination Tool
No. 439. Floor, Bench and Cabinet Scraper
No. 181. Aluminum Lane Level No. 108.
Stair Gauge Fixtures No. 470.

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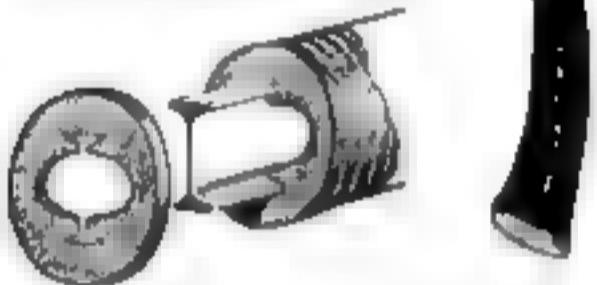


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DIRECTORS' CLUB

Sandpapering Made Easy

How to Rig Up a Hand Tool Grinder for Truing and Smoothing Small Pieces of Wood

By EDWARD THATCHER

SHIP model makers and others using many small pieces of wood which have to be fitted accurately together, will find that the simple sandpapering device illustrated saves much time and patience. With its aid small pieces of wood may be squared up quickly, and that is usually no easy task.

Most home mechanics number the hand tool grinder among their possessions. In place of the grinding wheel is mounted a wooden disk faced with sandpaper. A simple wood on table is made to support the work being sanded and a guide strip of wood may be attached to this table with brads, either at right angles to the sandpaper or at any required angle. The grinder may be driven with one hand and the work held against the guide and pressed toward the revolving sandpaper with the other hand.

The tool grinder and the disk sander, together with the table, are mounted on a flat strip of wood, which may be clamped to the bench or held in vise jaws. The grinding wheel may be replaced quickly for grinding or other wooden disks, faced with different grades of sandpaper or emery cloth, may be substituted.

Even shops equipped with a power disk sander or a lathe fitted with a disk sander, will find this little sander useful, as it can be attached to the bench near the work, where it will save many steps.

TO MAKE the sander, first remove the nut and grinding wheel from the grinder. From a block of pine or white-wood $\frac{3}{8}$ or 1 in. thick, saw out a disk of about the same diameter as the grinding wheel. The block should be thick enough so that when it is screwed on the threaded spindle of the grinder, the end of the spindle will not project beyond the face of the disk. Bore a hole through the center of the disk so that it may be screwed securely on the spindle.

Before turning up the face and edges of the disk, build the table on its supporting strip; then you may do the turning directly on the grinder. This strip and table are of any soft wood, but care should be used to see that the pieces are as true and accurate as possible. Particularly should the top of the table be square and true and at right angles to

the surface of the disk. The top should come up to the center of the disk. The dimensions of these parts will depend on the size of the grinder. This part of the work may be glued and nailed together, or, better still, glued and screwed.

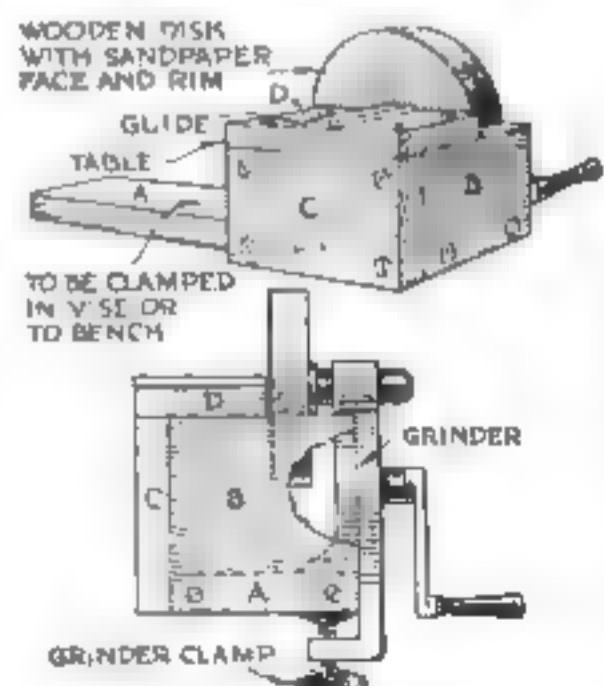
At one end of the supporting strip, A, is glued piece B and to this and the supporting strip is fastened piece C. At the

end of piece C and resting on A is another piece forming the third side of the bottole support of the table, D. Use a square when attaching the guide to the table top, if you are setting this at right angles to the sander.

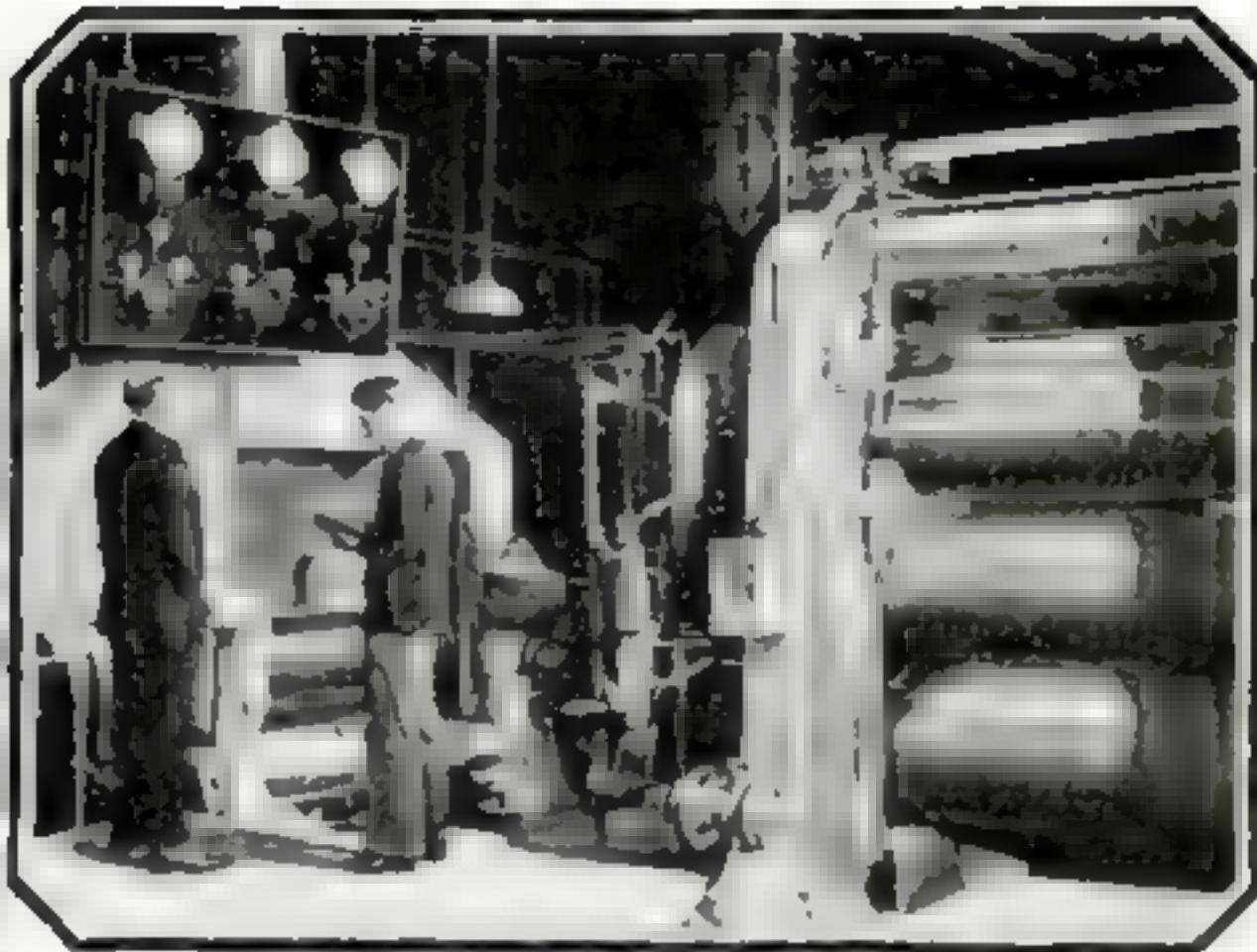
With the grinder clamped in place, see that the untrue disk is as square as possible with the table top and that it runs freely. Get a friend to turn the grinder handle for you while you use a small gouge to true up the face and surface of the disk. A chisel edge may be used to scrape the surface to a flat finish.

See to it that the face of the disk is square across and then glue on your sandpaper. A square piece may be used and trimmed around with a knife after the glue dries. A strip of sandpaper also may be glued around the outside edge of the disk and will be found useful as a drum sander.

For small work very fine sandpaper is best. Always bear with a light pressure.



A general view of the disk sander and how it appears from the working end



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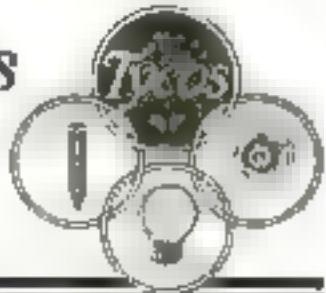
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Snow Canoes

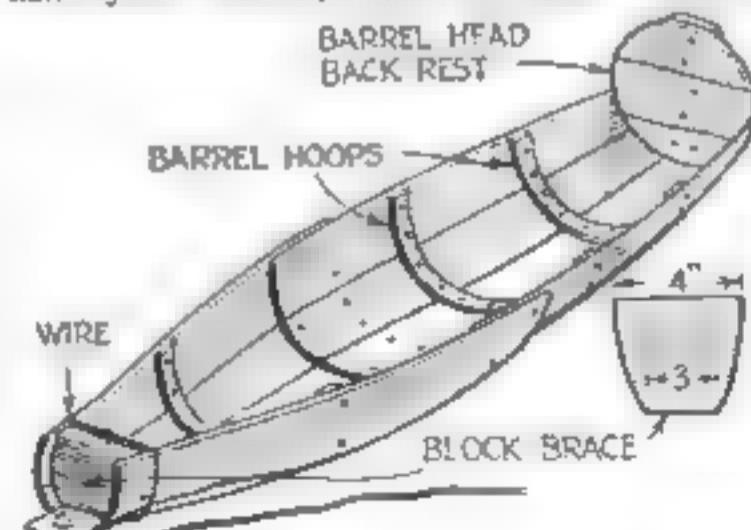
Made of Barrel Staves

By J. V. HAZARD

JANUARY'S snow lay deep in the hollows. Blistering winds had piled it there, leaving the surfaces glazed with a surface too hard for skis and too thin and rough for toboggans. The boys tried skipjacks, only to come to grief in the snow-filled valleys. Loose snow precluded toboggading on the road, and ice heavy enough for skating lay buried many inches deep.

Karl surveyed a broken skipjack ruefully. Something had to be done. There remained only a few days of the holiday vacation and neither he nor Jack had any intention of wasting those few days indoors.

"A toboggan would ride those drifts," suggested Jack, while his eyes wandered about the workshop where the boys stood—but she would split to splinters halfway down the hill, the snow is so thin."



How the larger "totyaks" are constructed, a smaller type is shown in the photographic illustration above

"Yes," responded Karl thoughtfully, "and it's too much to expect to find, or make, a smooth, wide track on any of those snow-covered hills. Now if we had a narrow gage toboggan—"

Jack's eyes lit and he bounded across the workshop, hauled an old apple barrel from its place in the corner and gave the head a resounding kick, knocking two of the three boards flying.

"Pick out the widest staves, Karl—those without holes in them. I'm going to make a sort of snow canoe—something that will run down the rough on a narrow bottom and ride the drifts, too!"

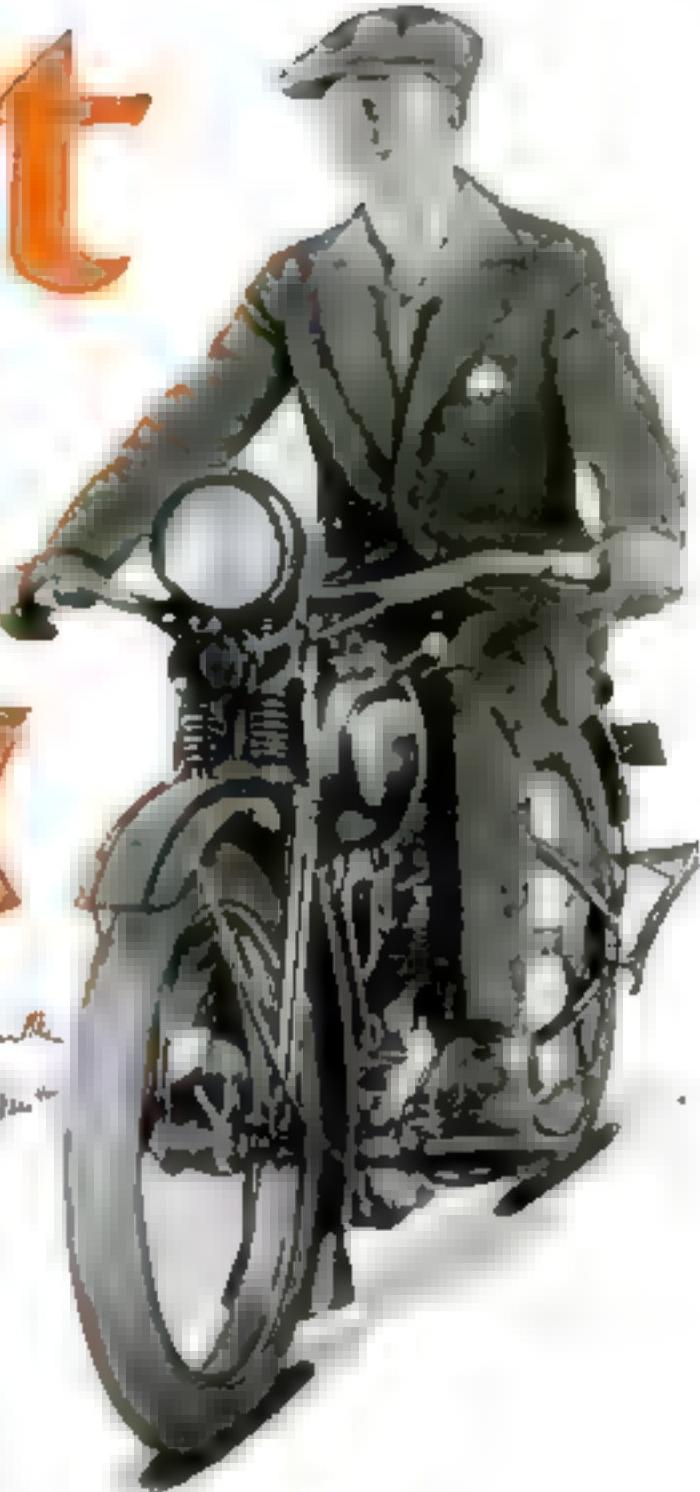
The boys tumbled pieces of hoop inside the wide staves selected, clinching the nail securely. The staves were held more or less in their original position, as shown in the accompanying drawing. One piece of the barrel head fitted the staves nicely and was nailed in and braced to form a back for the seat.

Another wide stave was now selected and nailed to the underside of the middle stave of the rear section, lapping it some 7 or 8 in. To the forward end of this stave was nailed a hardwood block 8 in. wide at the bottom and 4 in. wide at the top, by an inch or more in thickness.

The front stave now was tapered from where it joined the rear section to the lower corners of the block in such a manner as to make snug joints with two additional staves, which were attached. (Continued on page 85.)

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*America's lowest
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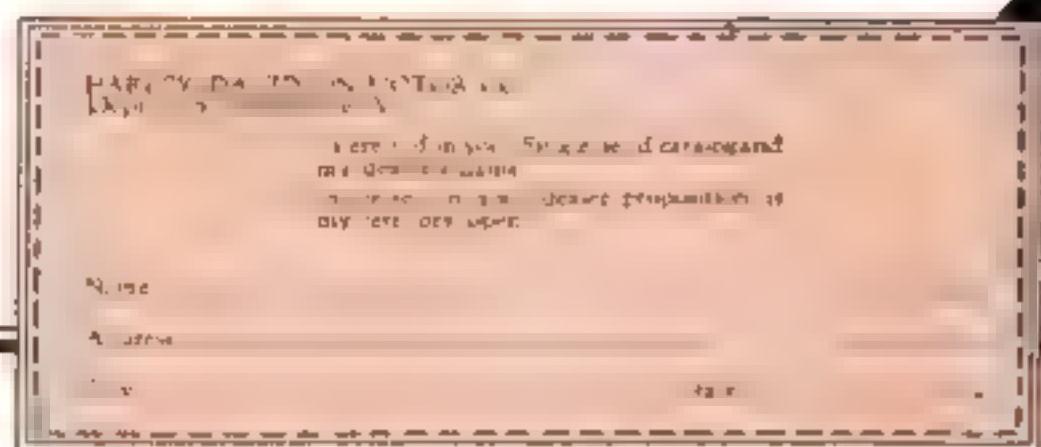
THE Harley-Davidson Single—new-type motorcycle—costs barely one cent per mile to operate! No wonder thousands upon thousands of people are adopting this amazingly low cost and dependable means of transportation. The cost is actually lower than street car or bus fare! Only one-seventh the cost of operating a low priced motor car!

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Installation Can be Made in a Few Hours Time

If you've planned to enjoy the benefit of automatic oil heat this winter and have put off installing your NOKOL, you'd be glad to know it's not too late. The NOKOL automatic oil burner can be put in any kind of heating plant with practically no interruption of service.

Now is really the time to enjoy NOKOL heat at its best. Just imagine what it means to turn over all your heating cares to this efficient oil burner and forget about the heating problem—all winter long.

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This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Whoa! This Rocking-Horse Runs Along on Rollers

By CHARLES M. MILLER

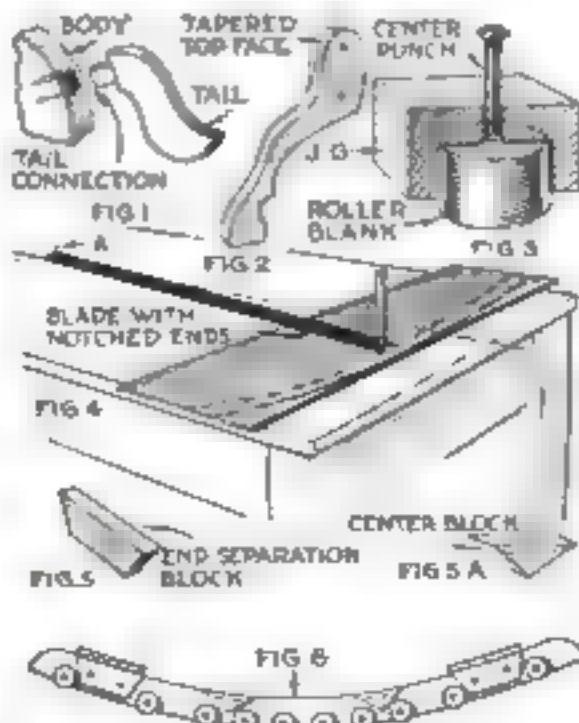
THIS colt is a cross between a rocking-horse and a roller coaster. It moves forward or backward according to the stress applied by the movements of the rider.

"Just an additional nuisance about the home?" you may say. But it is a new thrill for the youngsters and is intended for use outside, on sidewalks and porches as it does not perform well on rugs, or, for that matter, on lawns.

The outline or pattern of the various parts should be drawn full size on heavy wrapping paper. A screen of threads 4 in. apart was set before the horse when the illustration appearing on page 102 was made; these squares give an idea of the proportions.

The body should be cut from a board $1\frac{1}{2}$ in. thick, the head neck tail and legs are $\frac{3}{4}$ in. thick. The neck is set into a dadoed groove in the body, the dado being as wide as the thickness of the neck and at least 1 in. deep. The tail is mortised and tenoned or doweled to the body as shown in Fig. 1.

The legs must be tapered off in thickness toward the top (as in Fig. 2) so that they will spread apart at the bottom to brace the body. The shaping off can be



The colt and legs: how to center the wooden rollers and mark and assemble the rockers

done best with a rip saw unless one has access to a circular saw.

In this model the front legs are about 18 in. long, with a span of about 4 in. between the feet; the back legs are 16 in. long, with about the same span.

When the stage of fitting the horse to the rockers is reached, place the feet, which should be left at least $\frac{1}{2}$ in. longer than the final size, on the crosspieces which are to support them. Lay a thin strip of wood down on the crosspiece about one foot and mark a line on the foot. Do this on each side of each foot to show where to cut them off. The same method used for truing the uneven legs of a chair. This is important because the colt will be at an angle that cannot be

marked easily in any other way.

There are two pairs of rockers, the numbers of each pair being separated sufficiently to allow the mounting of rollers between them. The rollers which resemble raster wheels, may be of wood or metal. In making the rollers for the model illustrated, a $1\frac{1}{4}$ -in. round hardwood rod was cut into $1\frac{1}{4}$ -in. lengths in a miter box. The sharp edges were removed with a wood file.

The axles or arbors are $\frac{1}{4}$ -in. bolts, preferably with ends which are threaded only for a short distance. Two washers are used to separate each roller from the rocker pieces. If one could obtain brass tubing of the right size, it might be well to use it to make bushings for the rollers.

THE rockers in this instance were made of $1\frac{1}{2}$ -in. thick three-ply Oregon pine 18 by 48 in., sawed out on a radius of 42 in. The cut for the upper curve of one rocker formed the lower cut for the next so that no time or stock was wasted. How the board was laid out is shown in Fig. 4. The center line was first drawn and then a strip of wood with notches in each end was held against a nail A and used as a compass. The nail was then driven back 8 in. and another arc drawn, the process being continued until all were laid out.

The rollers must be centered and bored carefully. To do this quickly it is best to make a centering jig of a block at least $1\frac{1}{4}$ in. (Continued on page 102)



This is the Heavy-Duty Battery in which the new Layerbilt construction provides greater economy

There's an important discovery in radio economy awaiting all users of loud-speaker sets who have been buying the smaller Light-Duty "B" batteries instead of the large Heavy-Duty size required by such sets. Because the Light-Duties cost somewhat less to buy they seem like an economy, but the surprising fact is that the Eveready Layer-bilt No. 486 lasts more than twice as long though it does not cost anywhere near twice as much. It is, therefore, much more economical—we believe it to be the most economical "B" battery ever built. Certainly it has proved this by laboratory tests and the service it has given to radio listeners in their own homes during the past eighteen months.

Eveready Laverhilt's remarkable life

is due to its unique construction. All other dry cell "B" batteries are assembled of cylindrical cells, with much waste space between them, and many soldered connections bridging the gaps.

Several years ago we struck boldly out, away from this tradition, seeking a better method. We wanted to avoid waste space, minimize soldering, and get more current and longer life from a given quantity of active materials. The Eveready Layerbilt is the result.

This patented, exclusive battery is built in layers of flat current-producing elements, making automatic connection with each other. Every available inch inside the battery is occupied usefully. You get more battery for your money, and that battery is more efficient.

Remember this about "B" batteries: All loud-speaker sets require Heavy-Duty batteries, and the Eveready Lay-erbilt has proved time and again to be the longest lasting and most economical Heavy-Duty "B" battery.

Manufactured and guaranteed by
NATIONAL CARBON CO., INC.
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

Tuesday night is Eveready Hour Night—
9 P. M., Eastern Standard Time, through
the following stations:

WTAC-TV-Toronto
WJAS-TV-Philadelphia
WBEN-TV-Baltimore
WTAG-TV-Harrisburg
WFL-TV-Baltimore
WXXI-TV-Buffalo
WEAE-TV-Pittsburgh
WBAL-TV-Baltimore

WTAM-Cleveland
WJW-Pittsburgh
WGN-Chicago
WOC-Davenport
WBZO-Minneapolis
WCCO-St. Paul
KMO-St. Louis
WBAL-Baltimore

Old Pipe-Smoker Switches Back to Favorite Tobacco

Evidently, one way to appreciate a certain tobacco is to try another kind.

At least, that has been the experience of one veteran pipe-smoker. By switching temporarily to other tobacco he finally came back to his old-time favorite with a new appreciation and a vow never to change again.

Read this "signed confession."

Pearl, Ill.
Aug. 26, 1926

Moses Larus & Bro. Co.,
Richmond, Va.
Dear Sirs:

Just a confession and an appreciation. A number of years ago I was a user of your Edgeworth smoking tobacco. But like some others, perhaps, I was led by advertising advertisements to change.

A few days ago I went into a drug store to get some tobacco, and in the case was the famous can of Edgeworth. I bought it and, I am sure, I have enjoyed吸烟 comfort.

So my confession is that I made a mistake in changing to other brands, and my appreciation is such that Edgeworth will be my Brooks Pat while life lasts, which may not be long, for I have passed my "threescore years and ten."

Very truly yours,
Signed, S. P. Hubbard



Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth whatever and whenever you buy it, for it never changes in quality.

Write your name and address to Larus & Brother Company, 10-N S. 21st Street, Richmond, Va.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidores holding a pound, and also in several handy in-between sizes.

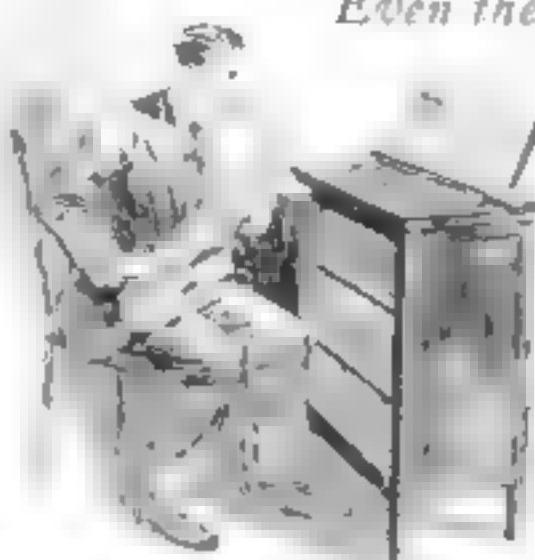
To Retail Tobacco Merchants. If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a doo- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

[On your radio—now in WYPA, Richmond, Va.—the Edgeworth Station. Wave length 236 meters.]

Music Cabinet with Built-In Rack

The Top Lifts Up to Form a Stand for Even the Heaviest Bound Volumes

By EDWIN M. LOVE



The unique rack attached to this cabinet supports bulky books just as well as sheet music.

THIS simple music cabinet has a top that folds back to form a rack capable of holding the largest music books. Other advantages are the adjustable shelves and the lightweight construction.

From 2 by 4 in. stock of whatever wood is selected for the cabinet, cut the four legs, 2 ft. 11 1/4 in. long and plane to 1 1/4 in. square. Mark the two best adjacent sides of each as working faces, to go outside the cabinet, and lay out on one piece the mortises for the front and side rails, gaging from the face sides. On an inner side of one, starting 3 1/2 in. from the upper end, gage two lines 1 1/4 in. long, one 3 1/2 in. from the working face, and one 3 1/2 in. Square across the ends, locating the upper front rail mortise.

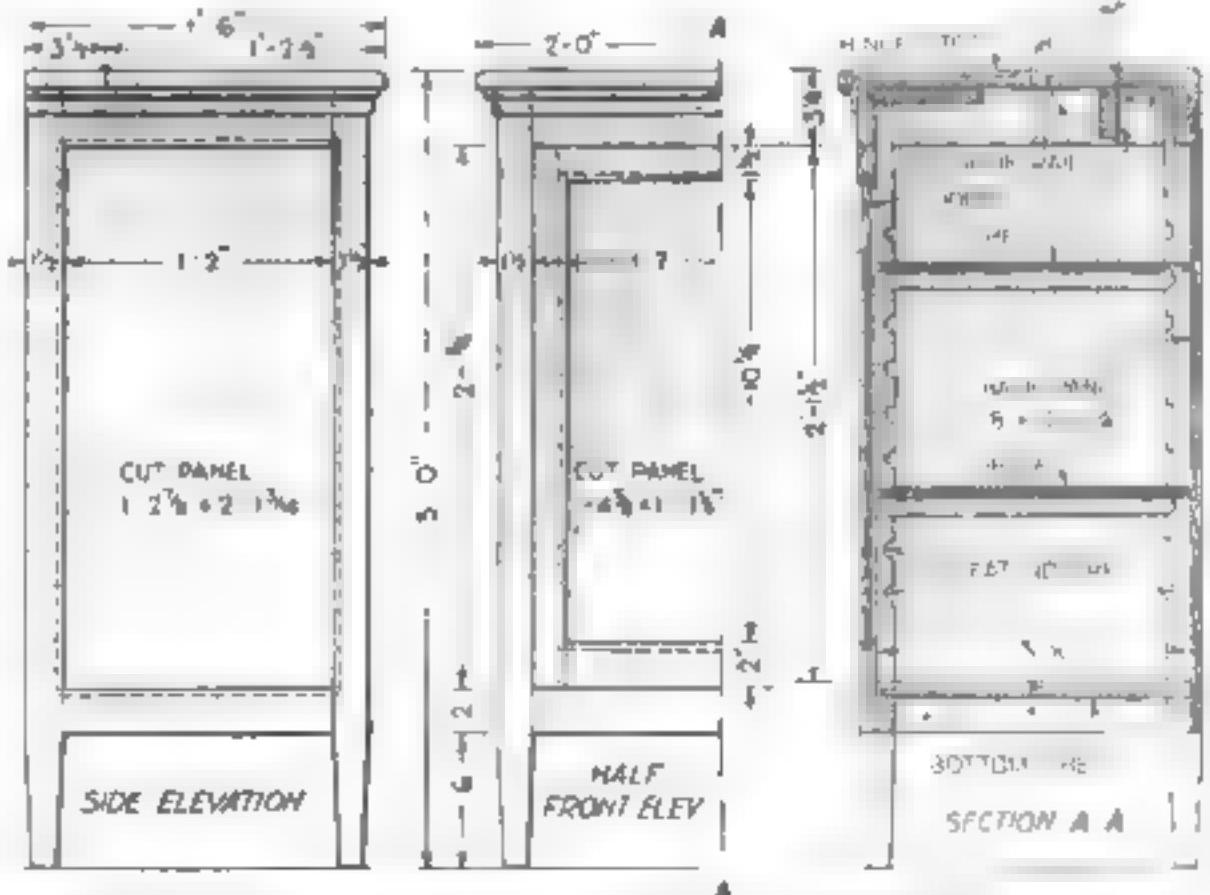
A similar layout for a mortise 1 1/4 in.

long is made 8 1/4 in. from the lower end. Gage for like mortises on the inner face, and chisel out to a depth of 1 1/4 in. Plow a 3/4-in. groove 3/8 in. deep and 2 ft. 8 1/4 in. long, 3 1/2 in. from a face side of each leg, beginning at the upper end of the leg. The groove is to take the side panel. Since a plow will not work the end of a groove that does not run full length of the stock, it is necessary to chisel out a short mortise at the blind end into which the nose of the plane can slide.

Taper the lower 6 in. of the leg 3/4 in. from each side, making the foot 1 in. square. Glue a plug 3/4 in. long into the upper end of the groove.

Make the other front leg the opposite of the first, to form a pair, using the first as a pattern.

THE back legs are made much like the front, but the lower back rail mortises are 8 in. long and are 8 in. from the lower ends. Cut a rabbit 3/8 in. deep and 4 1/2 in. wide in the inner back corners, to receive the back panel. Clamp together, side by side, a front leg and its back leg, and bore 3/8-in. holes 3/8 in. deep every 8 in., beginning 18 in. from the lower end and ending 7 3/8 in. from the top, all centering on the inner edges of the legs, which bear together. This forms the rectangular *Continued on page 105*.



Three views showing the construction in detail and suggesting suitable dimensions. By moving the cleats, it is possible to shift the shelves to suit whatever books and sheet music the cabinet is to hold.

Look up at your ceilings

HAVE YOU A CEILING that is cracked or falling? Do you need more living space? Would you like to build in a clothes closet? Does the garage need lining?



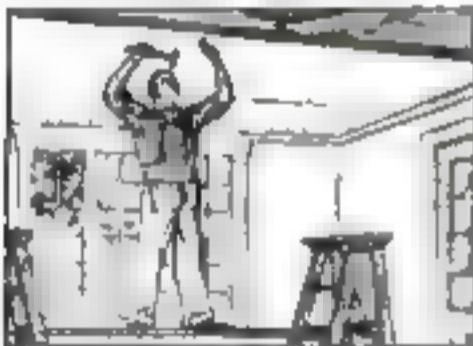
MAKE your old home new...with Upson Board!

Upson Board comes in big strong panels...so light one man can put it up, even on ceilings.

Then paint, apply the decorative wood trim—and your room is finished. No muss, no water, little delay. Upson Fasteners (patented) make Upson Board the one board with no ugly nail marks.

Re-cover cracked ceilings

Why be embarrassed by a cracked, ugly living room ceiling?



Put big panels of Upson Board right over the old plaster.

Finish in a beamed or paneled effect to harmonize with the furnishings (mail the coupon for

helpful blue print) and your room is permanently beautified.

Upson Board ceilings can never crack or fall—and properly applied, should never warp or bulge.

Snow-white bath or kitchen

Upson Fibre-Tile (Upson Board with permanent tile-like indentations on panel surfaces) will quickly build in a gleaming-white bathroom or kitchen—and at



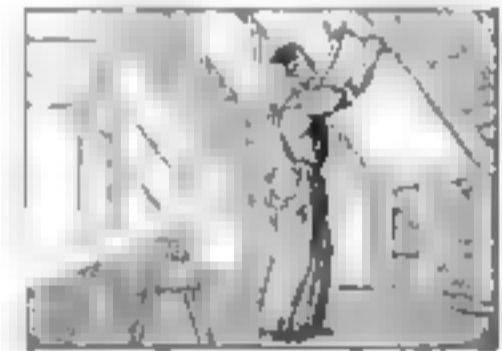
1/10th the cost of "porcelain tile."

Comes in big room-length panels that go right over plaster or old wainscoting. Enamel, and you have a waterproofed, washable surface of lasting charm.

Three to seven more rooms

Make your attic and cellar useful, too. Build in maid's room, extra sleeping room or bath, fruit closet, workroom, useful laundry.

At the same time the Upson Board lining will insulate your house—make it warmer in winter, cooler in summer—reduce your fuel bill 20% to 30%.



Get the facts today

Try Upson Board for just one ceiling. Then you'll want it all through the house.

Genuine blue-center Upson Board is different from anything you have ever seen. Tests prove it from 40% to 150% stronger than ordinary boards—an excellent insulator—the equal of 11 thicknesses of building paper. Dozens of letters in our files prove it resists fire, moisture, even ordinary leaks.

Ask your lumber dealer. Or we invite you to mail the coupon below for samples, literature, helpful detail-blue print.

UPSON
for walls . . . ceilings

MAIL THIS COUPON

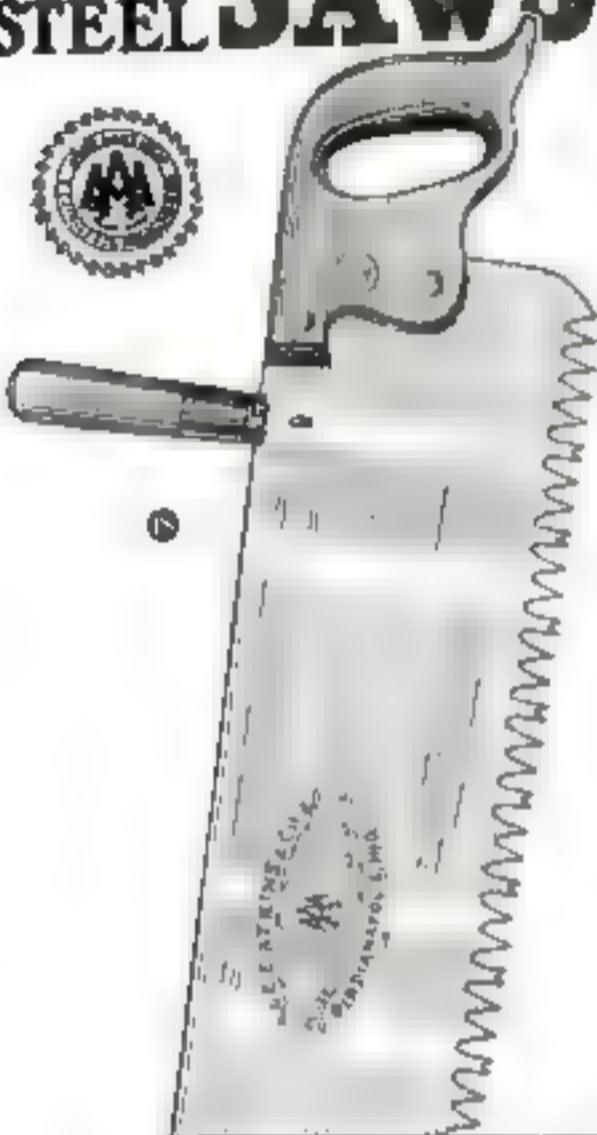
The Upson Company
327 Upson Pt., Lockport, N. Y.
Enclosed find 10c for samples, signature,
and full-size blue print for kind of room



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ADDRESS _____

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partitions . . . insulation

ATKINS SILVER STEEL SAWs



ATKINS Cross-Cut Saws Cut Faster— Last Longer

WHEN one man uses a cross-cut saw he must have the easier, faster cutting the ATKINS saw insures. He knows what it means to have the saw hold its edge longer. "Silver Steel" is the best material for saws. It is tempered and ground to cut faster and last longer.

The ATKINS name on the blade of any saw means time, money and labor saving. It pays to use better tools.

Ask for these free ATKINS Saw Booklets—

"Saws in the Home" or
"CROSS-CUT SAWs"

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Sawing Machines, Plastering, Trowel, and
Other Tools

428 So. Illinois St.

INDIANAPOLIS, U.S.A.

Dining Workshop

Dividends in Home Building

(Continued from page 67)

cleaned but also will not be damaged by even the hottest cooking dishes.

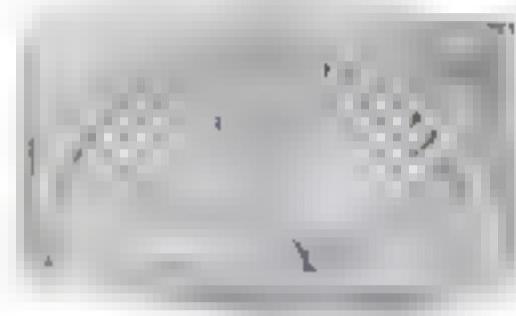
The problem of preserving perishable food for the current needs of the household can be solved in part and its cost lowered by building a cold closet over the refrigerator or in another location convenient to the kitchen.

The illustrations show more clearly than words just how the closet and ventilating shutter are arranged. The door over the ventilator may be closed during extremely bitter weather, as enough cold air leaks in around the edges to keep the interior of the closet just above freezing.

The closet itself should be made as tight as possible and the door carefully fitted to prevent the leaking of cold air into the room in which the closet is built. A fine copper screen is tacked over the outside of the shutter to keep out dust and insects. With such a ventilated closet, considerable ice is saved during the spring and fall months, while during the hotter periods additional storage space for nonperishables is available. By all means include a cold closet.

In the dining room the cabinetmaker can get in some of his most careful work by building one of the convenient corner china closets of semi-Colonial design. The work on this feature, however, can be done at leisure after the kitchen has been taken care of.

It is not necessary to make any special

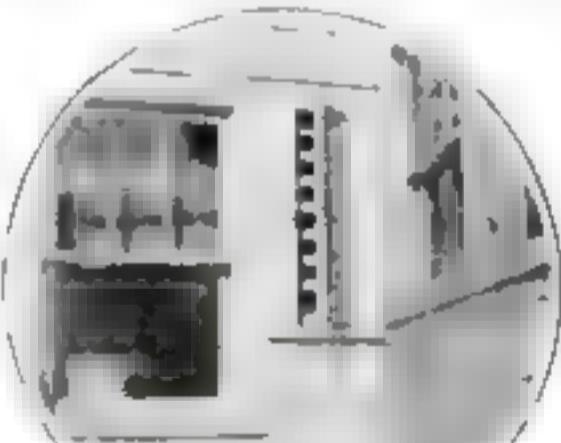


The nearly completed fan motif for the mantel front. The blades are separate pieces

previous provision for this closet as it can be built up right over the plastered and papered wall. Wood cleats are attached with screws directly over the wall paper and a false wall built up of $\frac{1}{2}$ -in. planed lumber. A full length doorway of standard height is faced in with the same design of trim used throughout the house and wall paper, which has been saved for the purpose, is hung carefully around it.

The upper glazed door is difficult to make on account of the curved glazing required, but this type of door is a standard part with millwork houses and can be bought at a fairly reasonable price. The lower door, however, is entirely of wood and makes an interesting job of cabinet-work for the amateur on account of the triangular panels. If the woodwork is stained mahogany to match the dining room furniture, the corner china closet makes a very

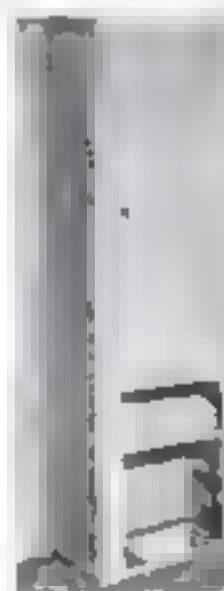
(Continued on page 85)



The ventilator for the cold closet is shown in the circle at the left; the closet itself is illustrated directly below it.



At the right is the corner china closet, built in after the house was completed.



Linen closet in bedroom (at left) with concealed chute for conveying soiled clothes instantly to the laundry

The Home Workshop

Dividends in Building

(Continued from page 84)

decorative as well as a useful addition to the room.

Another helpful accessory is the laundry chute. Ordinarily this chute is located near a stairway or chimney so that it can be concealed for its full length clear to the cellar. As the cellar is a rather depressing place at best, it was decided that this house should have a laundry on the ground floor in a back room adjoining the kitchen. This gave the handymen another opportunity to ply his art.

As the laundry is under one of the chambers, a 14 by 16 in. hole for the chute was left in the floor in one corner of the room and a closet built over it as shown in an illustration at the bottom of page 84.

The fireplace is frequently referred to as the heart of the home, and it is at least one of the most prominent of the



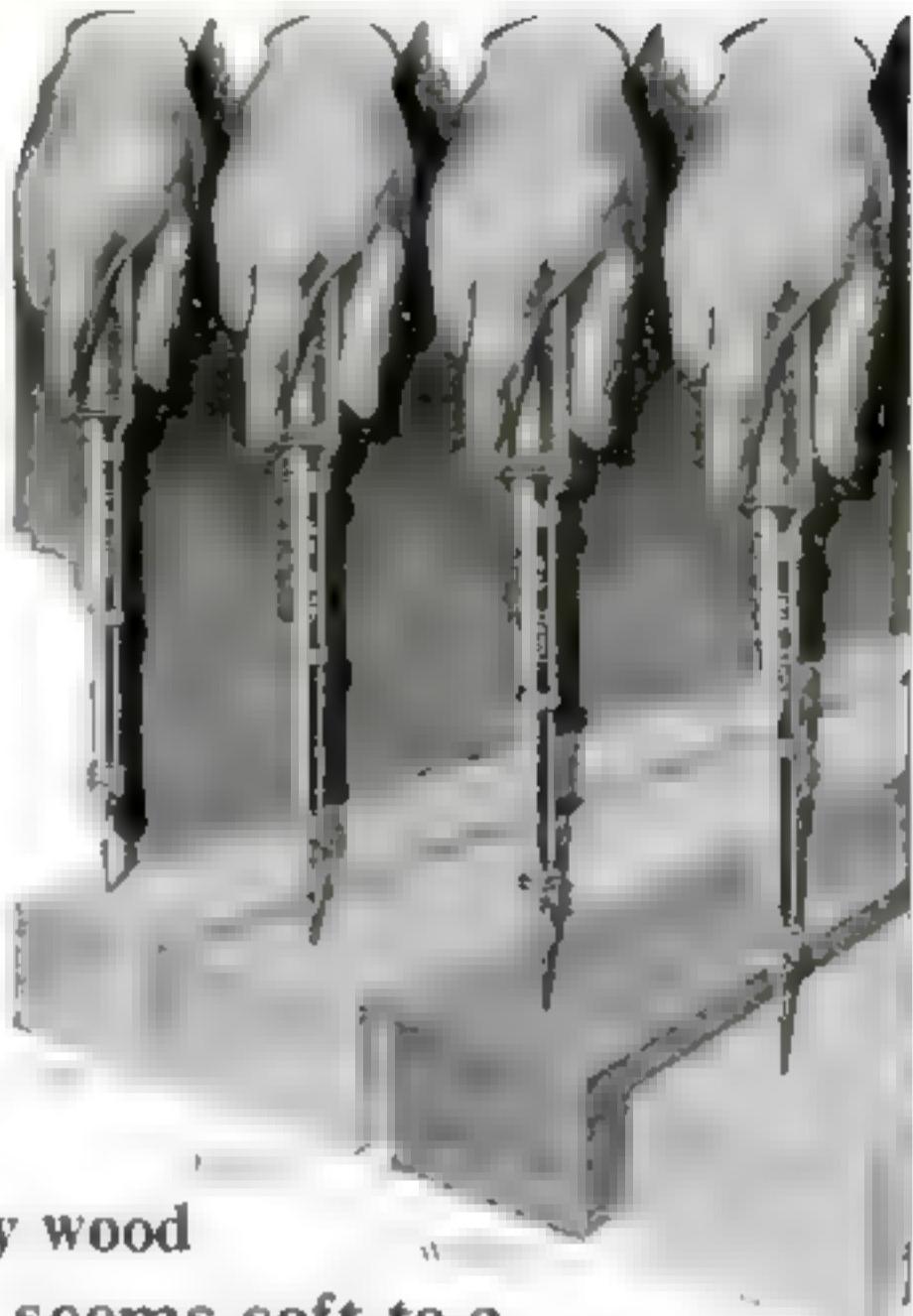
One of two permanent kitchen cabinets which were built on each side of the sink.

decorative features. It should, therefore, be given careful consideration by the designer.

The chimney, being placed near the center of the house to save building two chimneys and also to keep all the heat inside of the house, necessarily caused the fireplace to be built out into the living room. This afforded an opportunity to do some paneling in addition to designing and building the mantel itself.

The front part of the mantel, exclusive of the shelf, is made as a unit. The design was worked out by the use of nothing more than common modeling, which can be found at any woodworking shop. The fan motif was not carved, as its appearance would at first suggest, but was made by whittling, filing and sandpapering the separate blades of the "fan" and gluing them to a flat panel, which was later mounted in the center of the mantel. The photograph of the partly completed motif shows just how this was done.

As the woodwork (Continued on page 90)



Any wood seems soft to a “YANKEE” Push Drill

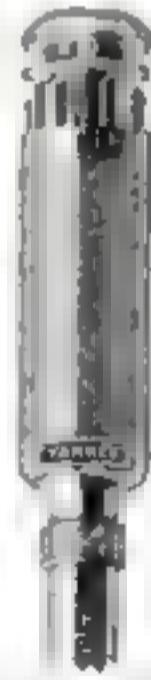
EVEN in the hardest wood, the action of “Yankee” Automatic Push Drills is unusually smooth and easy.

With only the slightest push, the point quickly bites its way inward.

“Yankee” ingenious design and “Yankee” superior construction reduce time and labor to a minimum.

Drill point revolves backward in upward movement of handle to clear chips.

No. 41 (illustrated). No. 44 has spring for regulating pressure according to nature of wood, size of drills, etc.



Febt. 1927
No. 41
Push
drill
1/8 in.
dia.
16 in.
long
Every one
of them
has been
made by
Yankee
individual
skill.

Some Other “Yankee” Tools

Ratchet Screw-drivers
Ratchet Breast and Hand Drills
Ratchet Bit Boxes

Automatic Feed Bench Drills
Ratchet Tap Wrenches
Vices, Removable Base

Write for Free “Yankee” Tool Book

The interesting little book is for all lovers of fine tools. It tells just what you want to know about all the famous Yankee Tools for working with power and quantity.

Dealers Everywhere Sell “Yankee” Tools

“Yankee” on the tool you buy means the utmost in quality, efficiency and durability.

NORTH BROS. MFG. CO., Philadelphia, U.S.A.



“YANKEE” TOOLS

Make Better Mechanics

The Home Workshop

A Hotbed Frame

(Continued from page 86)

shown, which has the advantage that it can be taken apart and stored away compactly in the cedar after it has served its usefulness in the winter and early spring. If the hotbed is to remain in place permanently, the same design can be followed, but the construction can be made still simpler. And, of course, the work of making the sash can be avoided by purchasing stock hotbed sash, which can be had for between \$3 and \$4 each.

To aid Frank in making his hotbed, I gave him the drawings similar to those reproduced at the bottom of page 86. I advised him to figure on a little clearance to allow the sash to slide easily. First he got the 3 by 3 in. posts ready and cut open mortises in the upper ends of six of them to receive the cross rails. The front, back and sides were boarded in with 1 $\frac{1}{2}$ by 10 in. common tongue-and-groove pine. A 1 by 2 in. cleat was nailed outside each corner on front and back.

FRANK set the frame together and pinned the slip mortise-and-tenon joints where cross rails join posts.

"Now bore holes and insert the six carriage bolts," I told him. "You see, by using this method of corner construction, it is possible in five minutes to set the frame up or take it down."

For the sash, we selected a few pieces of clear Michigan white pine, and Frank dressed all the stock to size with a jointer plane. The stiles (long side members), and the upper rails were made 1 $\frac{1}{2}$ by 3 in.; the bottom rails, 1 $\frac{1}{2}$ by 4 in., the sash bars, 1 $\frac{1}{2}$ by 1 $\frac{1}{4}$ in.

When the stock was ready, Frank laid out the mortises and tenons. I called his attention to the peculiar construction of the bottom rail, which in a hotbed sash is thinner than the stiles and is kept flush with the underside, so that the glass can overlap it. The end tenons on the bottom rail, therefore, do not have to be centered; they are flush with the top or face and have shoulders on two sides only. This became clear to him as soon as the parts were laid in position for marking.

THE glass rabbets were planed with a plow or rabbet plane, and a groove instead of a rabbet was plowed in the top rail so that the glass could be slid up into place. Provision was made in this way to use 10x12-in. stock glass without cutting or waste. When the parts were ready, they were fastened with casein (waterproof) glue and pins were driven through the mortises in all corners.

"Be sure to soak the sash in linseed oil before glazing," I warned Frank. "Then put a thin layer of putty in the rabbets and lay the glass on like shingles. Start at the bottom and overlap about a quarter inch. Use two hotbed sash staples to each sheet; then putty the outside."

The final step was to make frameworks of rough 1 by 2 in. strips and 1 $\frac{1}{2}$ by 1 $\frac{1}{4}$ in. lattice strips for holding rye straw like the one illustrated on page 86.



Accept 10 Days' Proof

Let us prove that the claims millions of men make for this unique shaving cream are justified

GENTLEMEN

Pullman car arguments never have yet proved a point.

That's why we make no claims for Palmolive Shaving Cream other than the fact that millions of men, once wedded to rival preparations, have shifted to this new creation.

Hence—that it is worth a trial. So we send 10-day tubes for that purpose. Will you accept one as a courtesy to us?

60 years of soap study stand behind Palmolive Shaving Cream. 130 formulas were developed and discarded before we found the right one. All our experience as the makers of Palmolive Soap, the

world's leading toilet soap, are embraced in this creation.

5 new factors

1. Multiplies itself in lather 250 times.
2. Softens the beard in one minute
3. Maintains its creamy fullness for 10 minutes on the face
4. Strong bubbles hold the hairs erect for cutting
5. Fine after-effects due to palm and olive oil content.

Just send coupon

Your present method may suit you well. But still there may be a better one. This test may mean much to you in comfort. Send the coupon before you forget.

THE PALMOLIVE COMPANY (Div. Corp.), CHICAGO, ILL.



10 SHAVES FREE

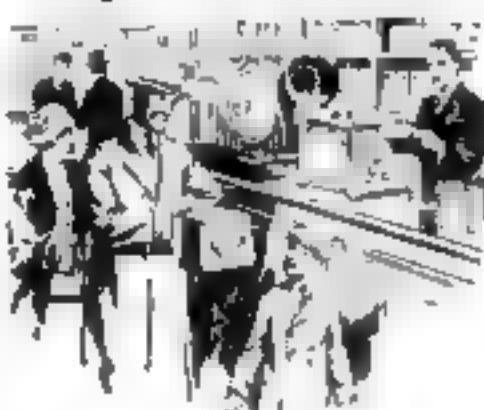
and a can of Palmolive After Shaving Talc

Simply mail your name and address and mail in Dept. P-12, The Palmolive Company (Div. Corp.), 3012 Iron Street, Chicago, Ill. Residents of Wisconsin should address The Palmolive Company (Wisc. Corp.), Milwaukee, Wisc.

Please print your name and address



This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.



Your New Radio Set

*Get Your
Money's Worth of Local
and Distant Programs
Use a
Beldonamel Aerial*



DISTANCE! That is the real test of your new set.

But don't forget that you cannot get the finest results unless you have a good aerial. Many good sets are permanently crippled because set owners mistakenly believe that corroded, soot-covered aerials are "good enough."

A corroded aerial reduces the volume and distance of even the finest radio set. That is why a Beldonamel Aerial should always be used. Each strand of a Beldonamel Aerial is coated with weather-proof, fume-proof baked enamel. Even after years of service, a Beldonamel Aerial is still as good as new. It cannot corrode. It always assures maximum distance and greatest volume.



Belden Manufacturing Co.
2304A S. Western Ave., Chicago, Ill.

The Home Work Shop

INLAYING Is Easy to Do

*And It Vastly Improves
Homemade Furniture
—Three Examples*

By HERMAN HJORTH

*Instructor, Architectural Laboratory,
Saunders Trade School, Yonkers, N. Y.*

INLAYING is often regarded by the amateur craftsman as a difficult process. This is because he has never seen how inlaying is done and, therefore, does not realize how comparatively simple and easy the process really is.

While inlaying is quite easy to do, it is a process that does not lend itself readily to machine production. Inlaid pieces of furniture command a good price by virtue of the handwork lavished upon them, while the painted imitations and plain pieces sell for very much less.

The home woodworker, who is interested and ambitious enough to experiment a little with inlaying, will be amply repaid for his trouble through the satisfaction he will experience in being able to make furniture not only of greater beauty and distinction, but also of greater intrinsic value—a value that can be measured directly in dollars and cents.

Inlay in general is made in two forms, lines or bands of varying widths and patterns, and inserts of a multitude of shapes and designs. This material is made by specialists. The lines are in pieces one yard long and vary in price from less than a cent to about twelve cents a yard. The inserts are sold by the piece; those described in this article cost from 50 cents or less to \$1 each.

When lines are to be inlaid, a groove



Fig. 1. Cutting groove with a modified saw

must first be cut in the wood of exactly the same width as the line and of a depth about equal to the thickness of the line. The tool for cutting such a groove (Fig. 1) can easily be made of an old back saw blade or similar piece of thin steel. It is ground down on an emery wheel to approximately the right width, after which it is sharpened on one side only like a chisel. The more carefully this sharpening is done the better it will cut. The spur is removed from an ordinary marking gage and this piece of steel inserted in its place (Fig. 4).

A groove is then cut with this tool, and if it is too wide the cutter is ground down. For the best results the groove should be so narrow that the inlay must be forced gently in place. This tool will cut grooves across the grain, but corners and awkward places generally must be cut and cleaned up with a pocketknife and a $\frac{1}{8}$ -in. chisel (sometimes ground down to $\frac{1}{16}$ in., depending

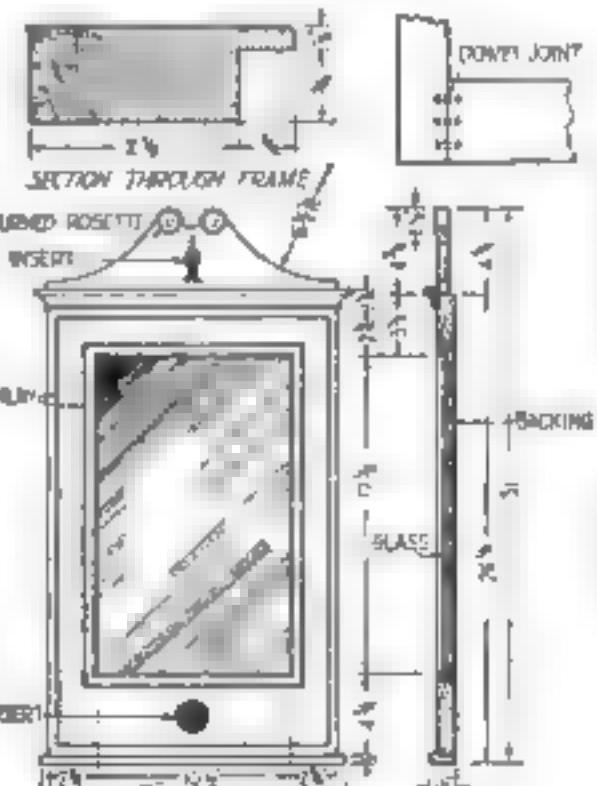


Fig. 2. Tray with border line and corner and center inserts, note alternative corners

Fig. 3. A mirror of one charm with inlaid lines, decorative inserts, and two rosettes

The Home Workshop**Inlaying Is Easy**

(Continued from page 84)

on the width of the inlay). It is recommended to make a cutter for the plain satin lines, $\frac{1}{8}$ in. wide. For wider lines, two or more cuts can be made with this cutter until the desired width is obtained.

When the grooves have all been cut and the corners cleaned, the lines are cut to length and mitered in the corners. Thin glue is then run into the grooves and the inlay forced in place with the aid of a hammer. The surplus glue should be wiped off with hot water and

the inlaid piece allowed to dry overnight. If an insert is to be used in the center, as on the serving tray (Fig. 4), it may be glued in place at the same time.

Inserts sold by manufacturers of marquetry are always glued in a

piece of brown wrapping paper and set in a piece of mahogany veneer. This surplus veneer around the edges is first cut away with a knife. The insert is then placed face down in the exact center of the tray, and a fine line marked around it with a sharp pencil. Draw perpendicular center lines both on the tray and the insert. If the insert is of an oval or circular shape, the outline is cut down with a sharp penknife, after which the wood in the center is cut away with a router plane. Set the plane to cut only a thin shaving at a time until the desired depth (equal to the thickness of the insert) has been reached. If the work has been carefully done, the insert should fit in the recess that has

(Continued on page 96)

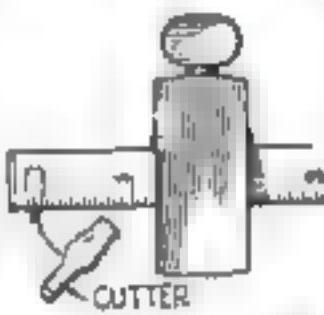


FIG. 4. Tool for cutting grooves made from common machine base.

Bill of Materials

No. Ref. T.	W.	L.	Part
1	14	20	Serving Tray
2	14	12 1/2	Bottom
3	14	10	Sides
4	14	10	Ends
5	14	10	Inlay
6	14	10	Center insert
7	14	10	Corner inserts
8	14	10	Mirror Frame
9	2 1/2	25 1/2	Sides
10	2 1/2	10 1/2	Top
11	2 1/2	10 1/2	Bottom
12	2 1/2	10 1/2	Top
13	2 1/2	10 1/2	Bottom
14	2 1/2	10 1/2	Molding
15	2 1/2	10 1/2	Backing
16	2 1/2	10 1/2	Rosettes (turned)
17	12	10	Inserts
18	12	10	Inlay
19	12	10	Plate glass
20	12	10	Frame
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215	12		



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The next time you're at the hardware store ask the man at the tool counter to show you the best hammer he has in stock.

Nine chances out of ten he'll hand you a Maydole.

Experienced hardware men know that no other hammer is built like a Maydole. The head is press-forged of selected tool steel. And the handle is of clear, second-growth hickory, air-dried for years and put on "for keeps."

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Maydole
Hammers
David Maydole Hammer Co., Norwich, N.Y.

Home Workshop

"Old Ironsides" in Miniature

(Continued from page 69)

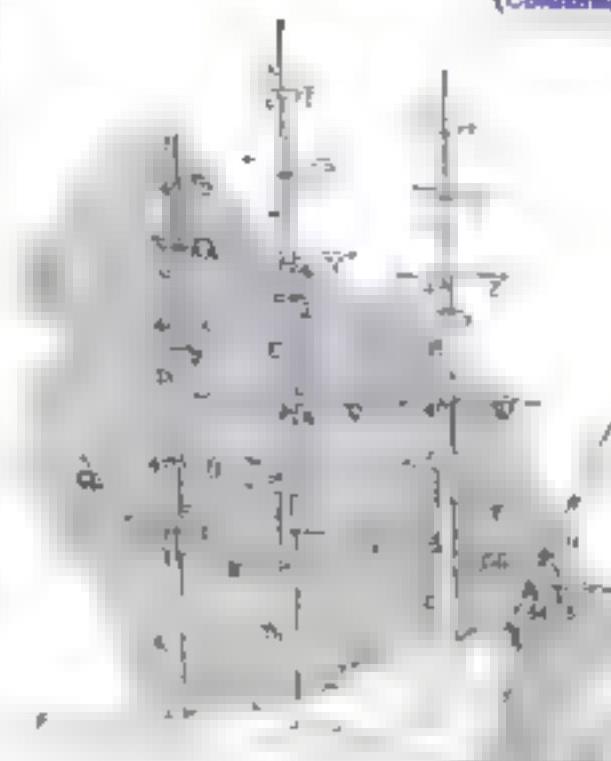


Fig. 3. The Spar Plan

A Mizzenmast	A-274	X Mizzen top-	
B Mainmast	A-274	Y Main top-	A-274
C Foremast	A-274	gallant	yard
D Mizen top-		Z Main top-	A-274
mast	A-274	gallant	yard
E Main top-		S Fore top-	A-274
mast	A-274	gallant	yard
F Fore top-		T Fore top-	A-274
mast	A-274	gallant	yard
G Mizzen top-		AA Mizzen	A-274
gallant	A-274	royal	yard
H Main top-		BB Main	A-274
gallant	A-274	royal	yard
I Fore top-		CC Fore	A-274
gallant	A-274	royal	yard
J Mizzen royal	A-274	DD Mizzen	A-274
royal mast	A-274	sky yard	yard
K Main royal	A-274	EE Main sky	A-274
royal mast	A-274	end yard	A-274
L Fore sky-end	A-274	FF Fore sky-	A-274
mast	A-274	end yard	A-274
M Bow sprit (outboard)	A-274	GG Spritboom	A-274
N Jib boom	A-274	yard	A-274
O Flying jib	A-274		
P Spanker	A-274	1 Tops	A-274
boom	A-274	2 Crossboom	A-274
Q Spanker gall	A-274	3 Topgallant	A-274
R Mizzenyard	A-274	crosstrees	A-274
S Mizzenyard	A-274	4 Caps	See Fig. 4
T Foreyard	A-274	5 Martingale	
U Mizzen top-		boom and	
gallant	A-274	top	A-274
V Main top-			
gallant	A-274		
W Fore top-end	A-274		
yard	A-274		

All dimensions are in inches. The length of A, B and C is to the deck.

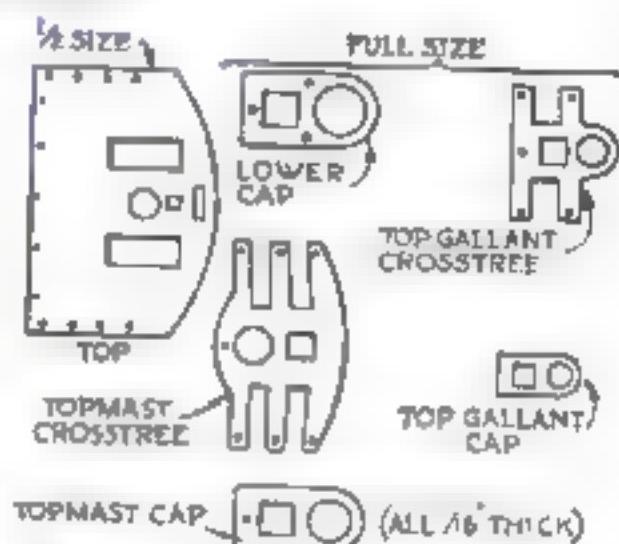


Fig. 4. The tops are of thin plywood and caps and crosstrees are 1/8 in. thick celluloid

Later they were stacked on the frigate deck, whether in the position given in the deck plan or not, it is hard to say. One Government model has the boats stacked at either side of the main hatch. Instead of two boats shown in Fig. 2, you may, more correctly, have five, two of which are stacked on the lower three.

They can be cut with a knife from a piece of pine. The tops are flat as if they had canvas.

(Continued on page 41.)

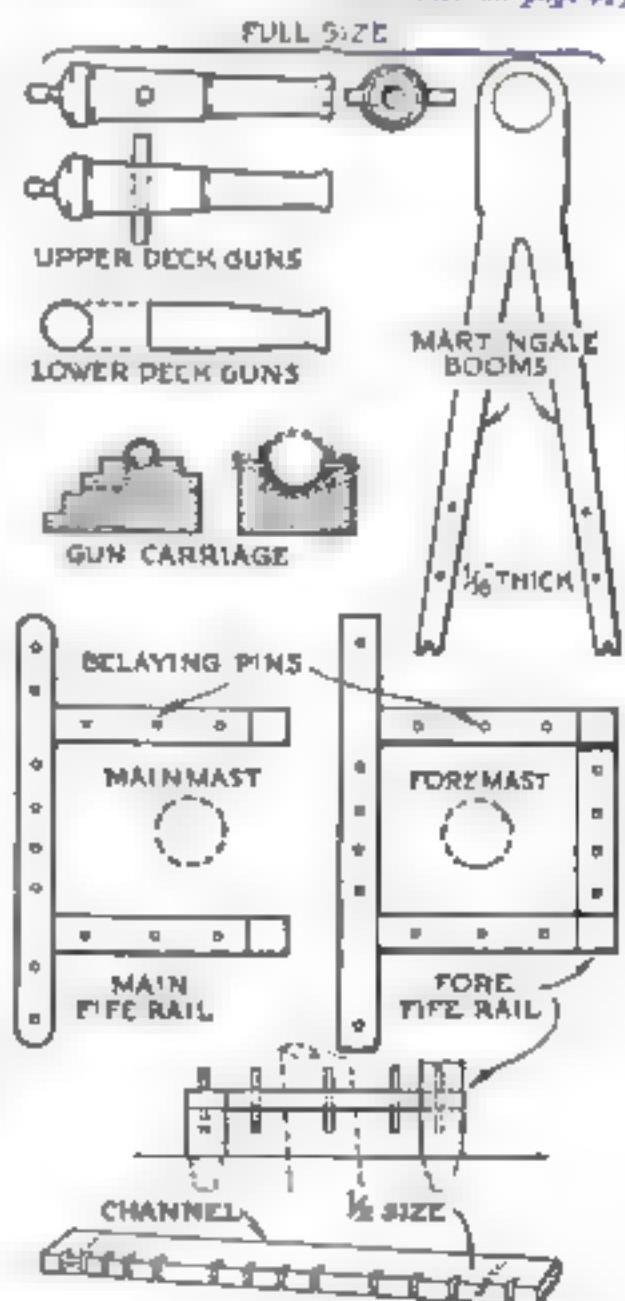


Fig. 5. Gun, martingale booms, pipe rails and channels. All but the latter are full size

painted brown, and the supports, green, can be made from thin celluloid, with a piece of stick between, and a wire through. The ends of the uprights should be glued into slots in the deck. A small rope may be glued in a hole in the deck on one side under the barrel, passed three times around it, and down to the deck on the other side; this would be the tiller rope, leading to the tiller on the deck below.

No position for the boats is given on the Government plans of 1807, upon which our model is based but it is presumed that in her earlier period they were carried on the gun deck and passed through the large hatch she then had.

The Yacht Modeler

"OLD IRONSIDES"

FULL SIZE



Fig. 6. The hatches and skylights; capstan, steering wheel and anchor, all actual size.

covers on (Fig. 7) but they also can be hollowed and given thwarts and other gear. They stand on chocks, which fit their undersides; to these they should be lashed.

The capstan (Fig. 6) is a piece of pine, round, with holes in the top edge for the capstan bars; these also may be made and shipped (inserted in the holes). There should be eight, evenly spaced and about $\frac{1}{2}$ in. long. The real capstan is an elaborately built-up affair.

The anchors (Fig. 6) may be cast in bronze or white metal or cut and hammered from a piece of lead. The shank should be $1\frac{1}{2}$ in. long and the stock a bit shorter. The latter is shaped in wood, then split in two, the two halves being glued round the shank and bound with thin thread. The anchor will be rusty black and the stock the same or dark brown. The cables will be pieces of chain, with simple links, of which there should be about eight to the inch.

That completes the fittings. The guns, steering gear, boats and anchors should not be put in position until the last because they

(Continued on page 24)

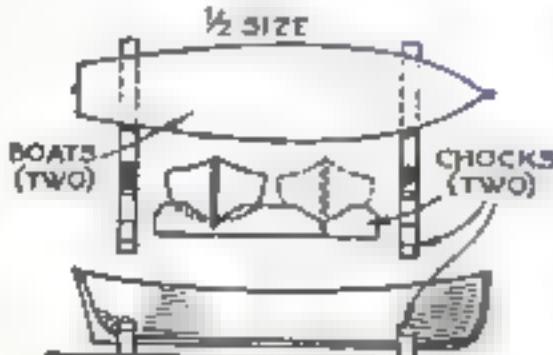


Fig. 7. The boats are whittled from soft wood and appear as if covered with canvas.



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that the subscriber desires. He speaks to the person he wants—wherever he may be.

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14" Band Saw

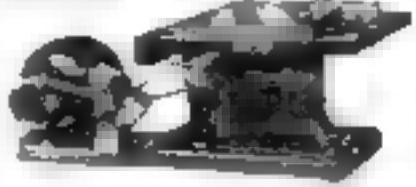
Table 72" x 14"
Width 48" depth 18"
Blade 7" wide
Tires blades 14"
In 1/2" wide
Brooks Bearings.

All tools driven by 1/2" to 1/4" H.P. motor mounted on right side.



B" Bench Lathe
Drive, turning, drilling, threading,
screwing, sanding, grinding and
planing 10" wood or soft metal.
Bearing 8" Capacity 14" between
centers.

Does ripping, mortising, grooving,
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W. S. & J. E. BOICE
Toledo, Ohio

See Home Workshops

"OLD IRONSIDES"

would be in the way of the rigging.

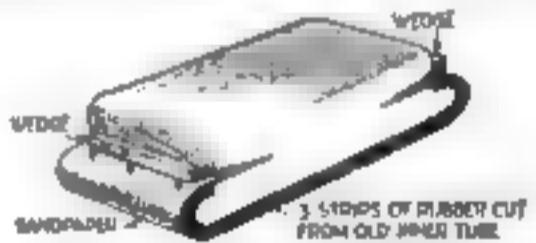
If the masts are now dry, bore holes in the decks to take them at the positions indicated on the deck plan in the January issue and on Blueprint No. 87. The masts will slope aft at an angle of 8 degrees from the perpendicular. The mainmast should take a little more than the fore, and the mizzen should take slightly more than the main.

The bowsprit may also be shipped, it slopes upward at an angle of about 30 degrees from the water line. The gammoning, which had better be passed at once to hold the bowsprit, is a thin, strong cord threaded about four times through the hole in the cutwater and carried round the bowsprit. It is then frapped (bound) together and knotted (Fig. 2). Get this tight.

Next month the rigging and finishing will be described. Meanwhile, if you are not conversant with the names of the parts of a ship and her rigging, hunt up a plan which gives these, they may be found in dictionaries, encyclopedias, and many books on ships.

Rubber Faced Sandpaper Block for Heavy Work

FOR heavy work the sandpaper block illustrated is particularly practical. To make one, rip a piece 8 in. wide and 6 1/2 in. long from a common two by four. The top of the block is cut back 1/4 in. from each end to a depth of 1 1/2 in., and two notches are made as indicated to receive



3 STRIPS OF RUBBER CUT FROM OLD INNER TUBE

The block is 1 1/4" by 3 by 4 1/4" in. and takes sandpaper torn in strips 3 in. wide

wedges. The lower face of the block is covered with three strips of rubber from an old inner tube, which are bent around the shoulders and tacked from above.

The sandpaper is cut into strips 8 in. wide without waste. A strip is fastened with a wedge at one end, carried around the block and then fastened with a second wedge. It takes but an instant to change the paper.—WILLIAM C. HARWOOD.

AS A manual training instructor, I have been asked frequently to restore to usefulness dull pencil sharpeners of the rotary type. After trying different ways of sharpening them, I found this to be the best: Take the sharpener apart and slip a piece of stiff wire through the hole in the cutter. Hold the cutter up to an emery wheel so that the steel can revolve freely while it is being sharpened. In this way a pencil sharpener can be made to cut like new.—M. J. HERTZ.

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Complete List of Blueprints

ANY ONE of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The corresponding back issue of the magazine, in which the project was described in detail, can be had for 25 cents additional so long as copies are available. The Editor will be glad to answer any specific questions relative to tools, material, or equipment.

POPULAR SCIENCE MONTHLY
930 Fourth Avenue, New York

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Send me the blueprint, or blueprints, I have underlined below, for which I enclose _____ cents

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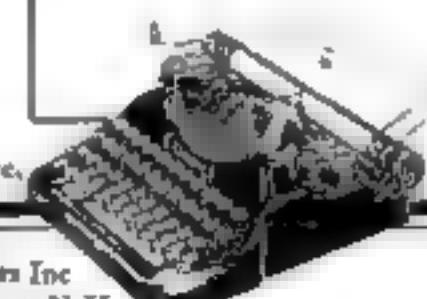
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What's power for "A" is power for "B"

—provided, of course, that you use a Rectigon. That's the one best way to keep both "A" and "B" batteries in topnotch form. There's no starving of batteries when you have this home charger to keep them full of pep. And, man alive, the unsuspected power your set shows then! Remember, too, that the bulb used for "B" battery charging is enclosed, like all other parts, in metal, free from harm. And keep in mind that your Rectigon will charge your automobile batteries.

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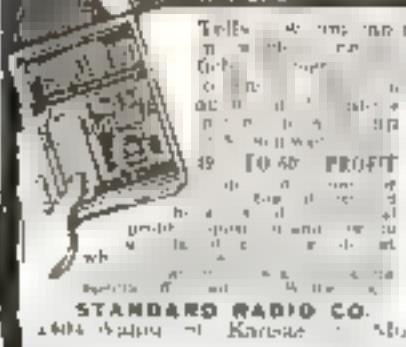


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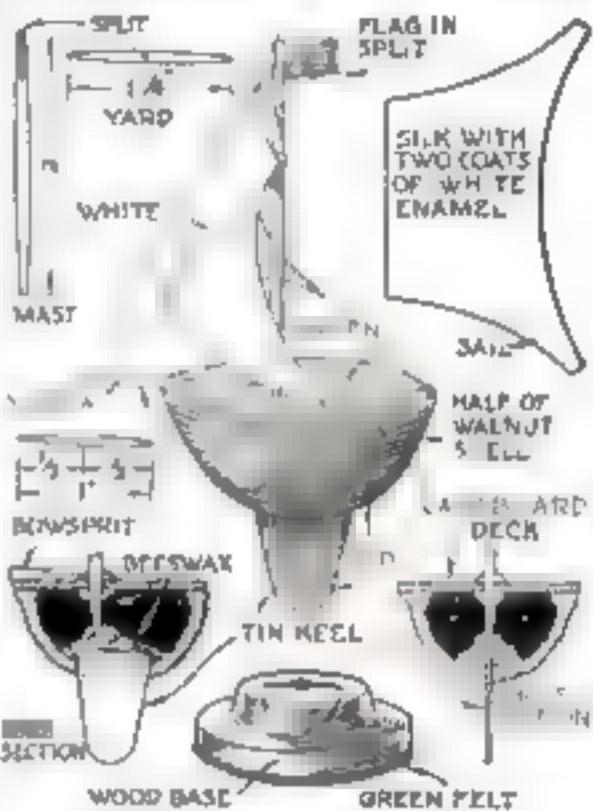
The Home Workshop

A Walnut Boat "Comicull"

By F. CLARKE HUGHES

HALF an English walnut shell forms the hull and a few toothpicks serve as the spars for this little "comicull" boat. Not only does it make a quaint and decorative novelty for a dinner favor, but, as it will float in a bowl of water, it is also just the type of toy to delight small children.

The half shell is rubbed flat on a piece of sandpaper so that a bit of cardboard can be glued or cemented on it to serve as the deck. Hot beeswax is an excellent



This model actually floats. It is one of a "comicull" series Mr. Hughes is designing for readers of POPULAR SCIENCE MONTHLY.

cement for this purpose as it is waterproof and easy to apply. It can be used also for fastening the tin keel in a slot cut through the shell and for holding the mast and bowsprit in place.

The sail should be thin silk treated with at least two coats of white enamel before it is put in place. Fine white thread is used for the rigging. The flag can be painted on white silk, either with a very small brush or a toothpick.

A section cut from a wooden spool will makes the stand when slotted to take the keel and given a coat of antique gold or other suitable color.

Give the model two or three thin coats of bright paint, enamel or lacquer. Then launch the little ship and test her seaworthiness. If carefully made, she should float high and be well balanced.

WALLBOARD joints and also small cracks and holes in plaster may be filled with a composition made of flour paste thickened with plaster of Paris. This is often used by paper hangers in concealing blemishes, as the paper can be placed over it immediately and it does not shrink noticeably or cause stains to appear.

The Popular Science Monthly

Snow Canoes

(Continued from page 7)

to form the sides of the forward section, or "bow" of the craft. These latter staves were first nailed securely to the rear section and then pulled in to meet the block at the bow.

Some little adjustment and a fit-and-tidy procedure were necessary, but by dint of patience, a "Yankee" windlass and some lay wire to hold the forward end of the staves in their final position, the task was accomplished. With a drawknife, Jack trammed the "gunwales" to a gentle curve from bow to stern.

Additional barrel hoop ribs were added and a hole bored through the projecting end of the center stave to take the "painter." With a piece of burlap for a cushion, the strange craft was ready.

"YOU see," explained Jack, "where there is only a little snow this will run on the center stave as narrow as a skier, and when it strikes a deep drift, I figure it will ride out on top. The faster we go, the higher it will ride! If this one works, we'll make another tonight."

The two christened their snow craft a "kayak," because it looked somewhat like half of an Eskimo's canoe. Off they went up the road with the kayak slinging in tow, and turned off into the pasture. They sank knee-deep, but the kayak rode lightly. There followed a stiff climb to the top of the ridge.

Jack took the initial ride, armed with an 8-ft. pole for steering purposes. Halfway down, in attempting to change his course, he bore down too hard and the sensitive contrivance turned completely about, dumping its load down the hillside.

Profiting by his chum's misfortune, Karl allowed the kayak to pick its own course. He streaked down the pathway already made and out on the deeper snow at the foot of the hill, the snow flying from the bow in exhilarating style. But he had not yet learned that he really was riding a craft requiring a canoeist's sense of balance. He rolled to port, slipped a load of snow and parted company with his craft in the deepest part of the drift, to the amusement of his chum, who danced a jig at the top of the ridge.

FURTHER experiment proved spills could be avoided by using the pole after the manner of a tight-rope walker, rather than as a steering device. From that point the sport progressed merrily.

Needless to say, evening found the boys busy on another kayak.

Snow kayaks can be made in smaller sizes for young children. The photographic illustration on page 78 shows a small size kayak, built for my son. This one, by reason of its size, has no ribs; the heavy piece of wood amidships is sufficient stiffening.

The material used for this kayak was taken from an old pickle barrel, and, being cedar, it is very light.

LIFE IS NOT WORTH LIVING —Without Sound Nerves

YOUR nerves govern your life — your efficiency, your happiness, your health. If your nerves are depleted, you cannot concentrate or think clearly; you have not the "pep" and spirit to enjoy your pleasures and sports, you have not the physical comfort and well-being without which happiness is impossible. Is life worth living under these conditions? Not. You merely exist—you are not getting out of life everything that it has to offer!

We are living in an age of SPLENDID we are leading, a *tiny* minute life. We crowd now, or even one year of life into a single year! We hurry, we worry, and often, we dissipate our vital forces through ignorance. We commit these sins because we are living in an age of acute competition, tremendously high cost of living, reckless pleasures—conditions that compel us to strain our nerves to the utmost.

Yet, we go on living our lives hard and fast, little realizing that we cannot go on for long, that there must come an end to our stock of Nerve Force, and that Nerve Exhaustion is staring us in the face!

Every victim of Nerve Exhaustion, when he is stricken with this terrible malady, firmly believes that he has been stricken suddenly. This is not true. The fact is, that it has been years developing, and that he has had many, many warnings of what was coming—but he did not heed them! Though he passes through years of subnormal nerve supply, he pays no attention, he believes it quite common—as many mind people do—to feel tired and worn out; to suffer sleepless nights in periods; to feel discomfort after meals; to feel depression, melancholy, and often in a temper a fog. He believes his trouble will leave itself "somehow" "someday" especially since his physician assures him that there was nothing physically wrong; that all his organs are perfect; that all he needs is a rest and now "he'll" all right. A little rest helps a little—for a while, and then he is right back where he started, leading the same old life. Finally he becomes a bit discouraged, believes that every man must endure "a few discomforts," and keeps going while the going is still good. Little does he realize that every day he is undermining his constitution, paving the way to all sorts of physical and mental disorders, and going through life only HALF ALIVE!

The country is teeming with cases that fit this story like a glove, for we Americans are the most nervous nation under the sun, not barring even the hot-headed Latin. They may be called "near-neurasthenics." A near-neurasthenic is but a next-door-neighbor to a full fledged neurasthenic, in the grip of actual, terrible and complete Nerve Exhaustion—Nerve Bankruptcy!

There is but one malady more terrible than Nerve Exhaustion, and that is its kin, Insanity. Only those who have passed through a siege of Nerve Exhaustion can understand the true meaning of this statement. It is HELL; no other word can



PAUL VON BOETTICHER
Author of *Nerve Force* and *Nerve Bankruptcy*. His books on Health, the Building of Health, the Phone and Auto and other *How-to Books*, of which he is best known, have been translated into foreign languages.

express it. At first the victim is afraid he will die, and as it grips him deeper he is afraid he will not die, so great is his mental torture. He becomes panicky, afraid and irritable. A numbing sensation of weakness and helplessness overcomes him. He becomes obsessed with the thought of self-destruction.

The symptoms of Nerve Exhaustion vary according to individual characteristics, but the development is usually as follows. First stage—lack of energy and endurance; that tired feeling. Second stage—nervousness, restlessness, sleeplessness, irritability, loss of hair, nervous indigestion, sour stomach, gas in

bowels, constipation, irregular heart, poor memory, lack of mental endurance, dizziness, headache, backache, tinnitus, rheumatism, and other pains. Third stage—serious mental disturbances, fear, undue worry, melancholia, dangerous organic disturbances, suicidal tendencies, and, in extreme cases, insanity.

If only a few of the symptoms mentioned apply to you, especially those indicating mental turmoil, you may be sure that your nerves are at fault—that you have exhausted your Nerve Force.

Perhaps you have chased from doctor to doctor seeking relief for a mysterious "something the matter with you." Each doctor tells you that there is nothing the matter with you, that every organ is perfect. But you know there is something the matter. Your doctor may prescribe a drug—a nerve stimulant or sedative. Leave nerve tonics alone. It is like making a tired horse run by towing him behind an automobile.

And don't be deceived into believing that some medicine or drug can cure you. It may be that your trouble is not in the nerves, but in the glands. Athletes have learned through better informed

I have for more than twenty-five years given the world the best in Nerve Force. Over 1,000,000 people have been cured through the book *Nerve Force*. You and your family can cure your physical and mental disturbances by reading this book in twelve hours.

Over a million copies of my book *Nerve Force* has been sold. It is the highest selling nerve book ever written. It may be that you would prefer to buy the book in the stores, but the stores have learned through better informed

I have for more than twenty-five years given the world the best in Nerve Force. Over 1,000,000 people have been cured through the book *Nerve Force*. You and your family can cure your physical and mental disturbances by reading this book in twelve hours.

Order *Nerve Force* today. It is not a pamphlet but containing my name but a real book of over 200 pages. The latest edition of *Nerve Force* is even more important than the first because it is limited to private pupils only. *Nerve Force* is available in many public libraries, and at the Medical Library, New York City. Thousands are recovering from nerve exhaustion by reading this book. Your money refunded if the book is not all you expect.

A person writes as follows:

"I am writing you as a subscriber. It is so that I have ordered

your excellent book on Nerves. I have done

so well already that I have

not tried any other book on the subject.

Now I have to tell you that I have a terrible

feeling of wonder and admiration.

I am a school teacher.

I had the opportunity of reading Paul von Boetticher's book *Nerve Force*.

I purchased it in our reading room

and have read it with interest and enjoyment.

It has been a great help to me.

They Challenge Perpetual Motion

What "automatic" machine really runs itself? What machine operator can you set working—and have him go on producing at his very best?

To expect high production without a Counter on a machine, is like putting trust in perpetual motion.

Better to trust in the "motive power" of always visible records—which call for an always creditable showing on

Veeder COUNTERS

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording the output or operations of small machines.

Operations of small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The farther

the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price \$2.00. Cut nearly full size.) Small Revolution Counter, also \$2.00.

The Set-Back Rotary Ratchet Counter below is for machines such as presses and metal-stamping machines where a reciprocating movement indicates an operation.



Registers one for each throw of the lever and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels as required. Price with four figures, as illustrated \$11.50 subject to discount. Cut less than 1g size. Set back Revolution Counter of similar model, \$10.00 list.

Write us about that counting problem of yours—or see how it's solved in the big Veeder booklet; copy free.

The Veeder Mfg. Co.
44 Sergeant St., Hartford, Conn.

Inlaying Is Easy

Continued from page 72

been cut. It is glued in place face down, with the brown paper on top, and is held in place by a weight. When it has dried overnight, it is scraped with a cabinet or veneer scraper. This removes the brown paper and brings out the pattern of the inlay. The corner inserts are inlaid after the one inlay has dried.

A serving tray such as illustrated in Fig. 2 is a serviceable as well as beautiful addition to the furnishings of the dining room. Before beginning work on it however it is well to ascertain if the dimensions given are suitable for the stand or tea wagon on which it is to be placed.

ITS construction is very simple. The bottom is made and inlaid as described above. The frame consists of four pieces put together with a rabbeted joint at the corners, as shown. The opening to form the handle is carefully laid out on one piece, after which the two end pieces are clamped together and a series of holes bored through them with a $\frac{3}{8}$ in. auger bit. The bits of wood left between these holes are cut away with a chisel and smoothed with scraper, file and sandpaper. It is better to cut these holes before cutting the outside shape and making the joints, because there is less danger of splitting.

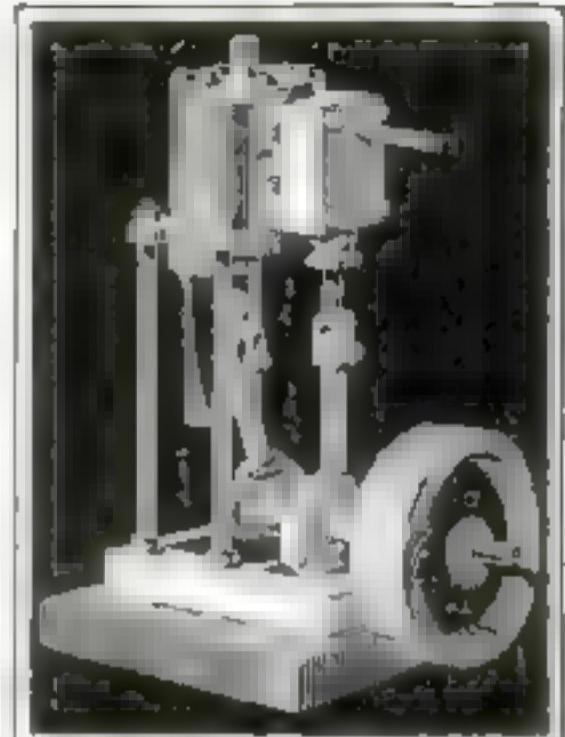
The frame is glued together, smoothed and sanded, after which it is either glued or screwed to the bottom. The writer has found gluing the easiest, if enough hand screws are available. It is not recommended to use a glass plate over the bottom, because dust will collect under the glass in time and make it unsightly, and if any liquid is spilled it is likely to run under the glass. If the tray is finished with linseed oil it will not be marred easily even if something is spilled on it.

The mirror (Fig. 3) is suitable for a hall, a parlor, or a bedroom. The four pieces forming the frame are first squared to dimensions, after which the rabbets are cut for the glass. They are then joined in the corners with dowels as shown, glued, smoothed and sanded.

THE grooves for the inlay are cut with the marking gage, the head bearing against the outside edges of the wood. The insert is glued in place as described above, after which the whole frame is scraped and smoothed. A small bead as shown on the drawing may be cut with an ordinary marking gage on the inside edges of the frame after it has been glued together.

The top piece is glued to the top of the frame after the insert and the turned rosettes have been glued in place. The joint is covered by a piece of molding, which can either be bought ready made or worked out with a gouge, scraper and sandpaper.

The backing should be of soft pine or whitewood and nailed in place. It is a good plan to place *Continued on page 74*



GET A HOBBY MAKE MODELS Start a Home Workshop

Model Making, by R. F. Baker, describes the construction of many game, gun, steam engine, motor car, boat, airplane, etc. models. Contains numerous plans of various nature.

It will be a joy to beginners as well as experienced. It will be very fun to do hard building with wood or leather work—tempering, drilling, planing, sawing, etc.

This is a book every amateur should have.

Model Making, the new 16-page catalog, price 50c, contains many interesting ideas. Please Postage 50c.

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250 Fourth Avenue, New York



This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop**Inlaying Is Easy**

(Continued from page 80)

several layers of paper between the glass and the backing.

The tea-table (Fig. 3) is a piece of furniture that is a little out of the ordinary. It consists of a tray hinged to a frame.

The frame is very simple of construction, consisting of five pieces joined by doweled joints. The side pieces each have two shaped pieces of the same thickness as the frame glued to them. These pieces may be beaded on the edges as shown by first gaging the beads with a marking gage and then slightly rounding them with a coarse, scraper and sandpaper.

The two sides of the frame are joined with the shaped stretcher at the bottom, which is mortised into them and glued in

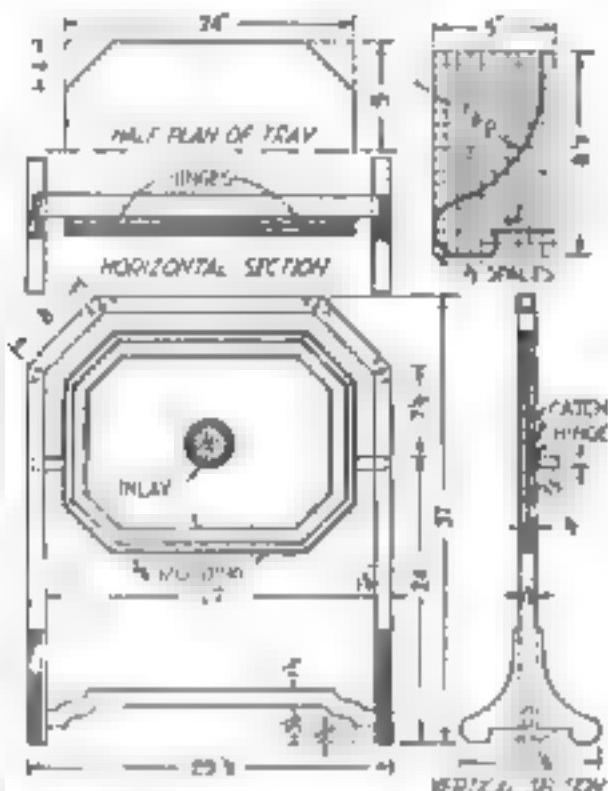


Fig. 3. When this distinctive tea-table is not in use, the top stands in a vertical position.

place. The piece to which the tray is hinged is glued and screwed to the frame.

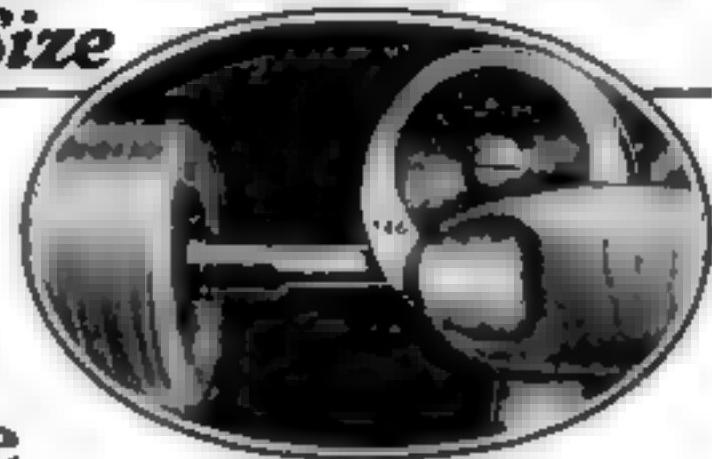
The tray, which is $\frac{1}{8}$ in. thick, is laid in, after which a moulding is fitted and glued in place flush with the edges. It is hinged to the crosspiece in such a way that when it is in the horizontal position it projects an equal amount on each side of the frame. The hinges should work rather stiffly so that the tray will not tip when placed in the vertical position. When used for serving tea (in the horizontal position), it is prevented from tipping by a catch, which locks it to the crosspiece.

If malogany is used for the three pieces of furniture described above, it is recommended to stain it with lime dissolved in water, as this does not discolor the inlay. If stained with bichromate of potassium or ordinary stain, the inlay has to be scraped afterwards with a very sharp knife to remove the stain, and this is a rather difficult and tedious process.

The limewater method of staining, mentioned by Mr. Hjorth, will be described in detail next month.



A NEW SPEED INDICATOR —Vest Pocket Size



Easy to Use Counts like a pulse



Speed indicators have been made before—but never one like this. The size of No. 746 alone makes it different from any other such device. It slips into the vest pocket as easily as a watch. Light in weight—only $1\frac{1}{2}$ ounces.

And it's accurate! Counts the hundreds of R. P. M., beating them out like a pulse. Easy-to-read dials give direct readings up to 100—giving you exact R. P. M. at any speed.

No. 746 is simple in construction. Only four major parts. And into its manufacture has gone the skill that has made Brown & Sharpe precision tools famous for accuracy all over the world.

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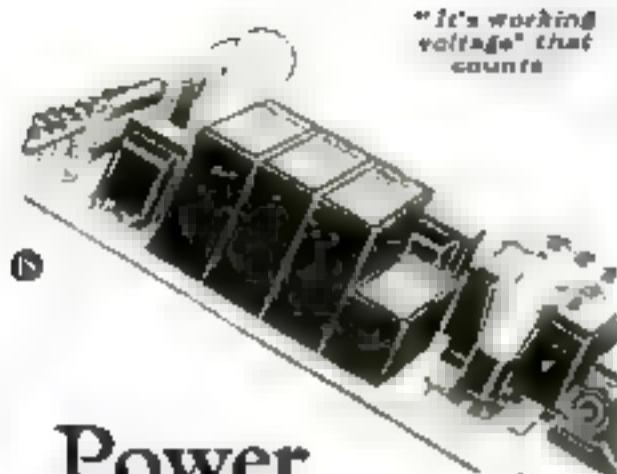
Illustration shows
Indicator actual size

BROWN & SHARPE TOOLS

World's Standard for Accuracy



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"It's working voltage that counts"

Power amplification has amazed the world

The amazing results obtained with power amplifiers is the radio sensation of the year. Perfect tone quality and the capacity to handle the full volume of a brass band without distortion, has made power amplification the "last word" in radio.

You, too, can enjoy all these advantages even with your old set, and at a minimum cost, by building a power amplifier with Dubilier Condensers.

Dubilier Condenser Type 903, illustrated, is designed to withstand the high voltage surges which often occur in the filter circuits of power amplifiers. In fact all Dubilier Condensers are built with this high margin of safety, and with an indicated *working voltage** that insures a long life in continuous operation.

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**Working voltage means more than "test voltage." It is the voltage at which a condenser may be safely used in continuous operation.*



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Home Workshop

How to Connect "Through Cord" Switches

By GEORGE A. WILLOUGHBY

Supervisor of Electric Work, Arthur Hill Trade School, Saginaw, Mich.

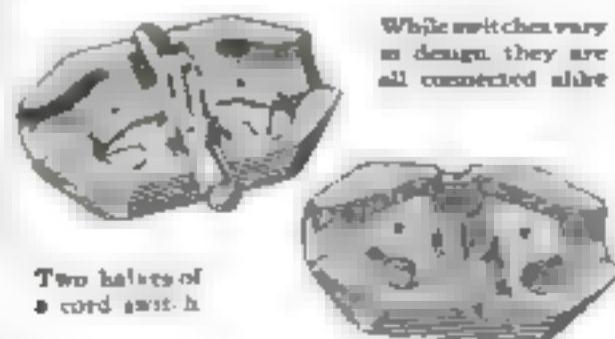


Strip the braid, then cut one of the wires and connect its ends to the switch terminals

A "THROUGH cord" or "feed through" switch has a place in the extension cord of practically every toaster, flatiron, or similar device. Not only is it convenient but it also makes unnecessary the constant insertion and withdrawal of the plug at the service outlet.

To install a through cord switch, separate the parts by removing the screws. Determine the desired position and split the cord, as shown in the circle above, just far enough to provide for making the connections to the switch but not enough to extend beyond its ends. Cut only the outer braid, which holds the wires together; leave the rubber covering on the individual wires unjured. The excess ends of covering may be cut off with scissors.

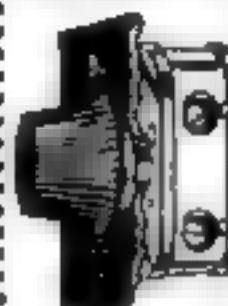
Cut one of the wires in two and remove the insulation from the ends with a knife held at an angle so as not to injure the wire. Leave the other wire with the covering intact. Twist the ends of the bared wires and wrap them carefully around the terminal screws. Trim off excess strands of wire and reassemble the parts. See that they fit perfectly before the screws are tightened.



Two halves of a cord switch

Bradleystat

PERFECT FILAMENT CONTROL



Provides complete noiseless filament control for all radio tubes without change of connections. Metal parts are nickel plated. One hole mounting. Self-contained switch opens battery circuit when

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Only \$100 Down

12 Month Payment Plan in Gold or Silver or Nickel

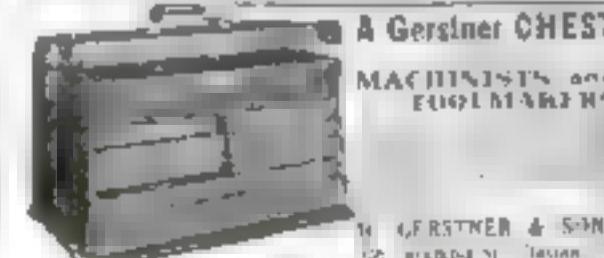
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Burlington Watch Co., 19th & J. Marshall Street, Kansas City, Mo.

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A Gersner CHEST
MACHINISTS and ENGINEERS

GERSTNER & SONS
121 W. BROAD ST., PHILADELPHIA, PA.

The Home Workshop

Dividends in Building

[Continued from page 83]

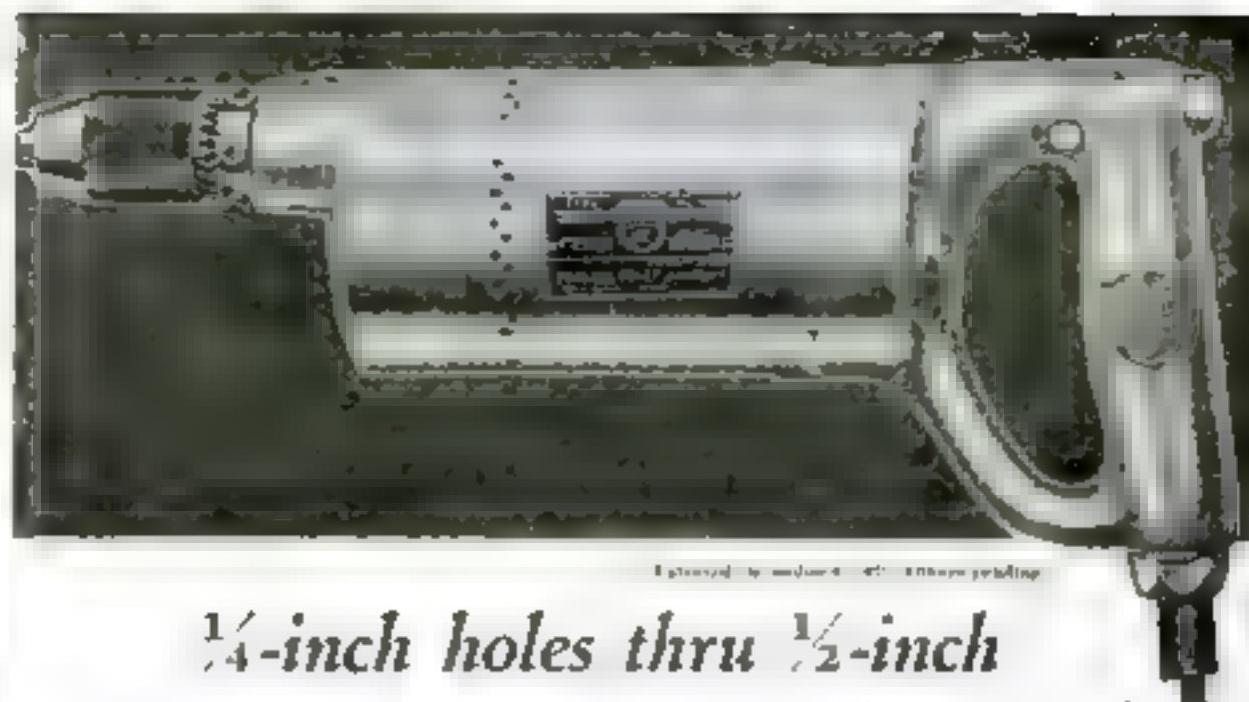


If the doors are purchased ready made, cabinets like these can be built very easily.

around the fireplace did not depend upon having any of the other finish work in place, as was necessary before the kitchen cabinet-work could be started, the mantel was the first job tackled. As the work of fashioning it progressed, it became more and more easy to realize why the contractor said it would cost about \$138 to build and set up the mantel shelf and paneling at the sides. When the time required to place the mantel and panels the sides was totaled up, it was found that it had taken the equivalent of four eight-hour days, and this was exclusive of the time to make the mantel proper and the small panel. No record was kept of the time required to make these parts, but a similar mantel was quoted at \$95 by a mantel manufacturer. As the materials cost only \$10, about \$145 was earned on the fireplace work alone.

On the exterior of the house there is little opportunity for the owner to do much work because of the necessity of covering the house and putting on the priming coat of paint as quickly as possible after the frame is up. On this house a special Colonial fan motif was wanted on the gable over the entrance, but the contractor said it would take a man a day to "fuss with it," whereas if it were shingled like the rest of the house an hour's work would "see it finished." As this meant the difference between \$1.25 and \$10 for a decorative feature, the contractor was told to leave the space unfinished. The central illustration on page 87 shows the result of a half day's work by the amateur, and although it did require considerable "fussing," the completed job gives constant satisfaction when compared with other gables.

All of these features may look like one of the seven labors of Hercules when first started, but in a surprisingly short time each job is completed and the only regret is that there are not more to be done.



1/4-inch holes thru 1/2-inch Cold Rolled Steel in 13 Seconds

No. 1042 1/4-Inch Heavy Duty Drill

NOT just one hole, but hole after hole, hour after hour.

No overheating—no letting up—no distress signs. The same smooth, dependable drilling for long periods.

A drill that performs like this in hard shop service won't go back on you.

No. 1042 is called a Heavy Duty Drill because it's motorized heavy enough to more than justify that

title. No job that comes within its range is too hard for this drill.

Uninterrupted performance is built into every part of every electric drill bearing the Goodell-Pratt nameplate. There are no weak points.

Write us for folder that tells complete details. Then order through your tool merchant. If he hasn't stocked your Goodell-Pratt Electric Drill, he can get it for you quickly.

Note these features and refinements of Goodell-Pratt Electric Drills

MOTORS—Powered for continuous drilling at the rated full capacity.

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EFFICIENT VENTILATION—Uninterrupted flow of clean air through the motor.

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GEAR OPERATED CHUCK—Ball bearing, with self-tightening action that makes the key unnecessary most of the time.

ACCESSIBILITY—Every vital part surprisingly get-at-able.

WIDE FACED HARDENED GEARS—Double gear speed reduction—hard bronze gear and spindle bearings—instant switch control.

HOUSING—Polished aluminum, with pleasing lines. Good looks as well as remarkable efficiency make Goodell-Pratt Electric Drills a real joy.

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1043	11	3/8" Heavy Duty	1100	1046	21	1/2" Heavy Duty	600
1044	12	5/8" Light Duty	700	1048	22	5/8" Heavy Duty	550

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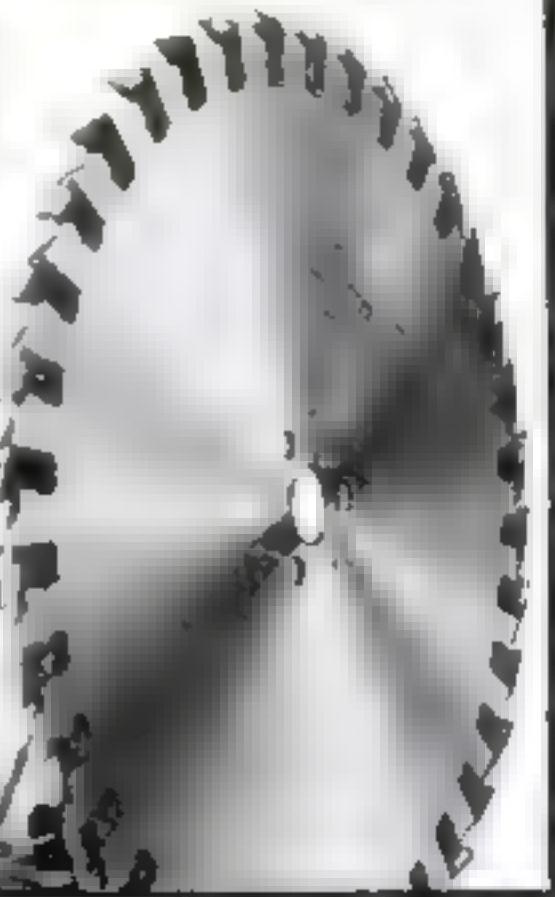
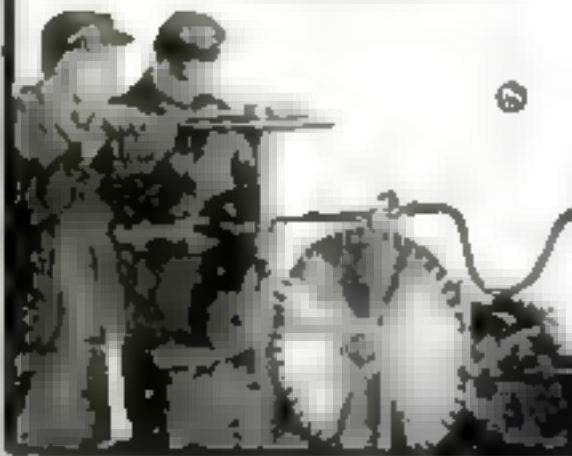
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SAWS FILES KNIVES STEEL

PARKS

WOODWORKING MACHINES



As rough as the wood is, it is your shop. It is a simple machine, being only a wheel, and whilst at the mill the carpenter makes a circular ring and crosses it with a cross piece, and so it is made. Next, when the wood is cut, the carpenter takes a sharp chisel and cuts out the middle part, and then he takes a sharp saw and cuts the wood into eight pieces. Then he begins his work. This is the action of a man. The only kind of a tool used is a saw and lathe, shaped as a lathe can be any time at any place. The man who does this work is called a carpenter, and the man makes a house as a carpenter who works in a workshop.

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Ms. Home Workshop

Now Kitty Can Open the Door Herself

By Frank J. Sibley

PLASSY can get in and out of the house by herself if a small swinging door is provided for her as shown in the accompanying illustrations. It can be inserted in the panel of a door or arranged to take the place of a pane in a cellar window.

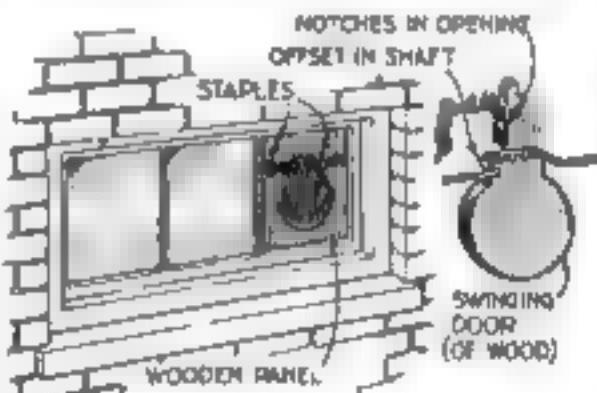
The opening can be cut with a keyhole saw or a coping saw blade. The panel of an ordinary outside door is usually soft pine, which can be cut by wrapping a piece of cloth around one end of a $\frac{3}{4}$ -in. coping saw blade and using it without a frame. Start the hole with a knife or small drill.



A private entrance
for the family cat

After the flapper has been cut out, round and smooth the edges with sand-paper and bore a hole for a wire shaft. Bend down one end of a length of wire, run the wire through the flapper, and then bend the other end, as illustrated. Place the wire across the hole in the panel and fasten with two staples at each side.

If the flapper is painted a different color than the door, as green against cream or white, you will find that most of your visitors will notice and comment upon this convenient door for the family cat.



The existing door can be cut to a wooden panel and placed in a cellar window.

Restorer for Checked Varnish

FURNITURE finishers, especially those who have to restore pieces of furniture that have become damaged, make use of what they call "remedial solvents." These contain solvents that soften the varnish and cause small cracks and checkes to run together. One formula is two parts of heavy bodied wood lacquer reduced with eight parts of lacquer thinner and one part of butyl alcohol. This is applied cautiously with a very soft brush after the surface has been lightly sandpapered. A second application can be made, if necessary, after the first has dried thoroughly and been sandpapered smooth.

The Home Workshop**A Block Puzzle to Test Your Wits**

By ERIC B. ROBERTS

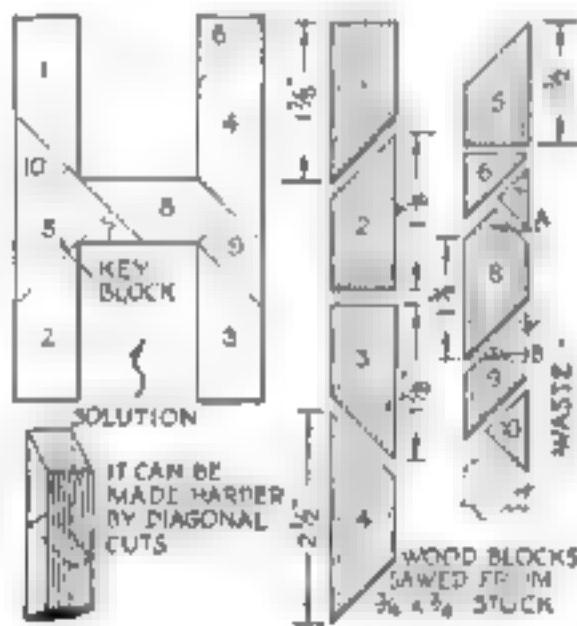
GIVEN the ten blocks shown at the right of the accompanying illustration, could you assemble them to form a perfect letter H?

It is not so easy as it looks, although the puzzle is one of the simplest to construct. The blocks are simply sawed apart in a miter box. No chiseling is necessary.

The whole trick lies in the fact that No. 5, which is the key block, is invariably taken to be the end of one of the uprights by those who have not learned the secret of the puzzle.

The blocks may be cut from any strip of wood $\frac{3}{8}$, $\frac{5}{8}$ or 1 in. square or, indeed, the pieces may be made of cardboard. The measurements indicated in the drawing are for blocks $\frac{5}{8}$ in. square.

Making the larger pieces will give no difficulty, but be careful to have the small



This puzzle is more deceptive than it looks because of the way the key block is used

pieces the right size and shape required before cutting them off as they are too small to saw afterwards. When No. 7 is sawed off, the point A of No. 8 will be thrown off center because of the thickness of the saw, therefore true the center before proceeding. Similarly be sure to shape point B of No. 9 before cutting off the block. No. 10, the last piece, is cut to fit, as it is slightly larger than No. 6. All the cuts, of course, are made at a 45-deg. angle.

To make the puzzle more difficult, some of the cuts may be made diagonally; if already too difficult, glue No. 7 to No. 8 and No. 9 to No. 8, or else cut No. 3 and No. 9 in one piece at the beginning.

It is perhaps best to draw a letter H the correct size and have the "victim" try to cover it. It will be exceedingly difficult even then.

Other symmetrical designs may be made with all or most of the blocks and the outlines copied and used as puzzles, but in every instance No. 5 should be used as the key.

DEPARTMENT MANAGER**Next in line—yet never chosen
—perhaps it's comedones***

FOR three years he had been next in line. They had given the Department Manager's job, with its high salary and prestige, to another. He never suspected that *comedones* kept him always "next in line."

It is a misfortune to suffer from comedones—the scientific name for blackheads. What's more, you may not even be conscious of them, though others notice them. Comedones often interfere with business success, for you can't be clean-cut and attractive when they are present. Do you wonder why you don't get ahead? Perhaps it's *comedones*.

Pompeian Massage Cream helps you overcome *comedones*. It gets in where comedones form, rolls out all the dirt and oily secretions. It stimulates a healthy circulation, keeps the

pores open, and gives you a clean, ruddy complexion.

Try this treatment

After you shave, spread Pompeian Massage Cream generously over your face—and rub. Continue to rub until the cream rolls out. Note how dark the cream looks. That's the dirt that was in your pores.

Don't let comedones form. Use Pompeian Massage Cream every day—especially when social or business engagements demand that you look your best. It means a healthy, wholesome skin. It means more joy in living.

***WHAT ARE COMEDONES?**

(*pronounced kom'uh-nayz*)
Dictionary definition: A small plug or mass occluding the excretory duct of a sebaceous gland, occurring frequently upon the face, especially the nose. Is often called blackhead.

**Use at Home after Shaving**

To get full pleasure and benefit, use Pompeian Massage Cream regularly at home after shaving. Your face will feel and look like a million dollars. Purchase at all drug stores.

TEAR OFF NOW! YOU MAY FORGET

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Dept. 30, Cleveland, Ohio

Gentlemen: Enclose 10c a dime, coin preferred, for a special trial tube of Pompeian Massage Cream.

Name: _____

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For 10c we will send a special trial tube containing sufficient cream for many delightful massages. Positively only one trial tube to a family on this exceptional offer. Use this coupon now.



Element-Lockt RADIO TUBES

What a Difference They Make!



(A) Two Ruthenium filaments with the three elements—filament and plate—in ONE UNIT. Larger than regular, the three elements are substantially spaced so the walls of no carb are not compressed against each other. This gives more insulation and maintains exact spacing. The COLD PLATE SPACING is ordinarily taken to insure ample, which are given for better quality, illustrations. This can be seen in the diagram. (B) Two Ruthenium filaments with the three elements in ONE UNIT.

(C) Insulating glass panels supporting the two Ruthenium filaments. These are made from insulating glass obtained by U.S. Bureau of Standards.

(D) ELEMENT, ground sheet impregnated with resinous charonite, used to insulate against the tube ends of life.

(E) PLATE, specially treated, heat resistant material.

(F) GLASS STEM, extra wide for added insulation support to the three elements.

What a Difference in Reception!

Seaver Williams' ELEMENT TUBE Tubes have been found to be especially valuable in distant signals. ELEMENT tubes give greater amplification than ordinary tubes, and are especially good for receiving distant signals. You will be able to hear the difference. Your friends will think you have a new radio.

SOLD DIRECT at introductory price \$1.50. Made to sell for \$2.50 worth. To popularize our new tubes, we feature them at introductory price. It is up to the radio enthusiast to buy them. You can receive a book of radio stories or one of our 10 books. Tell your radio dealer about it, and he will be interested in TUBE TUBE. Write us for details.

A FULL 1000-HOUR GUARANTEE

Should any tube prove defective within 1000 hours, we guarantee to replace it FREE of charge. Address: SEAVIER-WILLIAMS CO., Boston, Mass.

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in prompt time.

Check type desired
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Address _____
SHIPMENT of the App. Total G and Special Price for 1000
hours. Money back if satisfied. Price \$1.50
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THE chisel edge on the end of the claw makes this hammer a cutting tool of a hundred uses, without altering the claw feature. Small side claws make it easy to pull nails in close corners. The off set position of the nose gives far greater leverage—pulling ten penny nails with ease. A perfectly balanced one-pound hammer forged of tool steel. If your dealer cannot supply you write us direct.

Price \$2.00

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HAMMER COMPANY
R. A. Ayer—Dept. B
Hoboken, N. J., U. S. A.



If You Like to Draw— You Can Do Etching in Easy New Way

By HARVEY H. DUGG

ANYONE who enjoys drawing—and many amateur mechanics are skilful with pen and pencil—can make what appear to be etchings by a new, simple and inexpensive method.

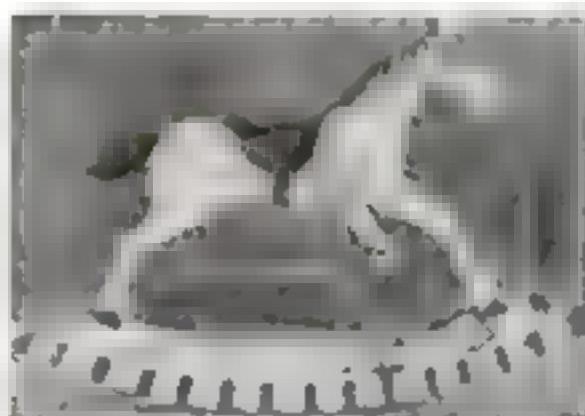
The method, as described hereafter was originated by Dr. George Lee Eaton, of the staff of St. Francis Hospital, San Francisco, for making drawings of peculiar conditions encountered in operations performed by him. Several New York artists have made use of substantially the same process for purely artistic purposes.

The etching is done on an unused photographic plate, 8 by 7 or 8 by 10 in. The artist draws his picture with a needle inserted in a wooden handle, or with the point of a stiff drawing pen.

No attempt is made to shield the plate from the light. When the drawing is completed, the plate is developed, just as if it had been exposed in the camera. When the plate is dry prints are made from it in the same manner as photographic prints. Wherever the artist drew a line in the etching, a black line appears in the print.

This Rocking-Horse Runs

(Continued from page 10)



The 3-in. squares in this illustration are to be used in drawing the parts full size

thick, as shown in Fig. 3. First drill a $\frac{1}{2}$ -in. hole perpendicularly through the block, then with an expansive bit bore a hole just large enough to allow a roller to be inserted endwise for a distance of 1 in. With a $\frac{1}{4}$ -in. bit bore the rest of the way through the block. Now, to center a roller, place it in the large hole and mark the center with a $\frac{1}{4}$ -in. bolt that has been filed or ground to a cone-shaped point at the threaded end.

The spacing for the rollers in the rockers must be regular. Both pairs should be exactly alike so that the corresponding rollers will operate at the same time. The rollers extend $\frac{1}{2}$ in. below the lower curve of the rockers. This would place the centers $\frac{1}{2}$ in. above. A line, therefore, is gaged $\frac{1}{2}$ in. above the lower curve and the centers are laid out $\frac{1}{2}$ in.



An Alaskan scene reproduced from a 5 by 7 in. photo-etching by Dr. George L. Eaton

and where there are no lines, or between the lines, the print is white.

Shading of the lines is effected by varying the depth to which they are cut in the film; the deeper the cut, the darker the line will be, until it becomes entirely black when the needle point is allowed to reach the glass beneath the film.

Aside from its use in the making of surgical drawings, the method has been used successfully by draftsmen, inventors and architects to make and preserve delicate mechanical sketches. The botany and zoology departments of a number of California schools are using the new method in making permanent records of plant and animal life.

By the use of ordinary carbon paper designs, mechanical drawings and pictures, even portraits, can be transferred to the film-coated plate, and etched.

part. Fasten the rockers together with brads before boring the holes. It is much more convenient to use a drill press, if available, as the holes should be perpendicular.

Care should be observed not to interchange the rockers or to get the ends reversed at any subsequent stage of the operations. The second and fourth rollers from each end may be omitted as there is not as much need for them to



An alternative design for a smaller horse. The body head and tail are in one piece

be close together at the ends as in the central portion.

Assemble a pair of rockers with the rollers in place and add spacing blocks a little thicker than the combined width of rollers and washers (Figs. 3 and 3A). The end blocks have the crosspieces screwed to them so they must be spaced to suit the stretch of the horse's feet. Note Fig. 6. (Continued on page 114)

Home Workshop

This Rocking-Horse Runs

(Continued from page 102)

which shows a rocker with one of the side pieces removed.

In the model the horse is placed a little forward of the center so that the front blocks are nearer the front end of the rocker than the back blocks are to the rear. These blocks are about 4 in. long. Two other smaller blocks are used in each pair of rockers as separators in the center.

Fasten the feet of the animal, after they have been fitted as previously described, with screws from the lower side of the crosspieces. Fasten a block to the crosspieces between the front feet and a similar block between the hind feet, then additional screws can be inserted through the legs into these reinforcing blocks.

Foot rests to take the place of stirrups may be suspended from the body of the horse. These are $\frac{3}{4}$ by $1\frac{1}{2}$ by 10 in. maple strips but it would, perhaps, be better to use pieces $\frac{5}{8}$ or $\frac{3}{4}$ by $1\frac{1}{2}$ by 12 in., as there could be more holes for adjustment. Toward the bottom a $\frac{3}{8}$ -in. dowel passes through both strips and extends far enough to form the foot rest. A similar dowel passes through the neck to act as a handgrip.

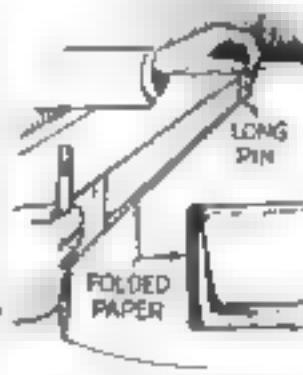
There is a knack to riding this broncho. He will rock peacefully enough in one place, but a little special stress thrown at certain points in the rocking motion starts the toy rolling forward and sometimes backward. This develops into a continuous rolling motion.

The tendency is to make the model too small. The one shown is really too small for little Eugene Pickelt, the five-year-old boy who is seen taking a ride on it. It is a simple matter, however, to make a larger model because the 8-in. squares used as reference lines may be increased to 8 in., thus making a horse one half larger.

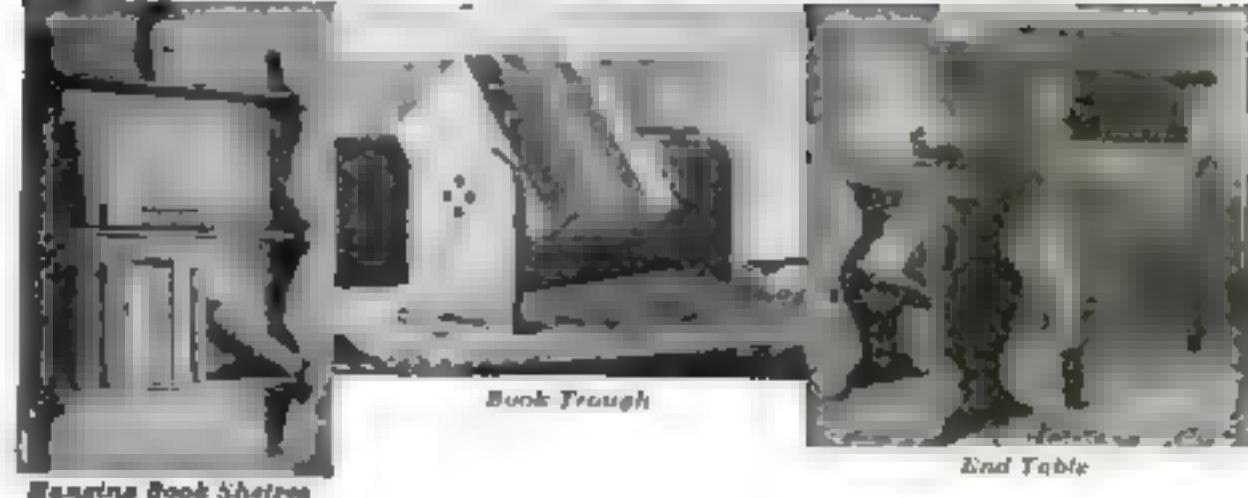
A donkey, lion, goat, rabbit or any of the animals seen on a merry-go-round can be substituted for a horse in building one of these curious toys.

Strip of Paper Serves for Drawing Large Circles

DRAWING a large circle without a beam compass is accomplished easily with a strip of newspaper or wrapping paper 8 or 4 in. wide and several inches longer than the radius of the required circle. Make two folds lengthwise to prevent tearing and to give stiffness. Lap one end around a lead pencil and pin together. Double the other end of the paper and put a heavy pin through to act as a center point.—JOHN M. LANE.



A quick, easy way to swing a large circle



Handiest Tool In your Work Shop

PERHAPS you have never thought of the special advantages of using LePage's Liquid Glue. It is always ready for immediate use. No waiting, soaking or heating is required. The quality is always the same. It "sets" slowly enough so that you have plenty of time to place the joints together exactly as they should go. Now setting so slow allows LePage's to penetrate the wood, increasing the strength of the joint. LePage's Liquid Glue is equal in strength to any animal glue. Buy a can for your work shop. It is the easiest, quickest, handiest form of glue. Insist on LePage's.

Recipe for making LePage's Gesso

To make one cup of LePage's Gesso, you need 1 mill can of LEPAGE'S GLUE. Take 1 cup white 3 transparence flour, 1/2 and 1 teaspoon cream of tartar. Place above in mixing bowl and pour in water in this order: LEPAGE'S GLUE, liquid oil and cream of tartar. Mix well. Agreements obtainable at nearest hardware store.

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Home Workshop

Music Cabinet and Rack

(Continued from page 104)

to another member, as in the body of the cabinet, but in a door it means a poor fit and the projecting of one corner after atmospheric changes have acted upon it.

The upper back rail is 1 ft. 7 in. from shoulder to shoulder, has no groove, and is tenoned in the opposite direction on the tenons. The lower rail is 2 in. wide, with tenons full width.

The front rails are like the side rails, but are 1 ft. 7 in. from shoulder to shoulder, and have no grooves.

Assemble the sides with the front and back rails, square up, and tack strips across the top and bottom diagonally to hold the cabinet rigid until dry. Cut two triangular blocks from 1 by 4 in. stock to size, and glue in the front corners, flush with the top.

Bill of Materials

No.	Pcs.	T	W	L	Part
		in.	in.	in.	
1	1	1	2	8 ft.	Cabinet rails about 1 in. wide and 1 in. thick
2	2	1	3	8 ft.	Legs
1	1	1	3	8 ft.	Top and bottom tenons
1	1	20	4	1	2-ply panel veneer
1	1	16	7	1	2-ply panel veneer
1 pair	1	13	13	1	Fast paneling clips
1 pair	1	13	2	1	Lower gun barrels
		5			Friction catch

All dimensions in inches except as otherwise noted

Cut the glued up shelf stock 1 ft. 8 1/2 in. by 1 ft. 8 1/2 in. Notch the back corners 1/4 by 1 1/4 in. and the front corners 1/4 by 1/2 in. To carry the bottom shelf, screw 1/4 by 1 1/4 in. cleats inside the lower rails, making the lower edges flush with those of the rails. This allows the shelf to show a 1/4-in. margin of the front edge above the front rails to act as a bottom stop for the door. Nail the ends with sixpenny finishing nails, and close the end cracks with triangular strips.

Make movable cleats of panel veneer 1/2 in. longer than the lower shelf, with notches 1 in. deep for leg clearance. The cleats are 1/2 in. thick, 3/4 in. wide, and 1 ft. 2 1/2 in. long, with both ends semi-circular.

The sides and upper rail of the door are of stock sized to 3/4 by 1 1/4 in.; the lower rail is 2 in. wide. Cut the rails 1 ft. 5 in. long, and bore the dowel holes before cutting full width tenons to fit into the stile grooves. Groove the inner edges 1/4 in. deep.

The stiles are finished 2 ft. 1 1/4 in. long, but it is well to leave an extra 1/2 in. on each end to prevent splitting the stock when the dowel holes are bored and when the door is being assembled. Locate the dowel holes by using the rails as patterns. Plow the grooves last.

The fixed section of the top is 3/4 by 3 1/4 in. by 2 ft. It is attached to the cabinet by means of cleats screwed to the upper side rails and nails driven at an angle through the back rail. Make the hinged top 1 ft. 2 1/2 by 2 ft. with a 1/4 by 2 1/4 in. by 1 ft.

(Continued on page 106)

Charges 6 volt
"A" Battery at 1/2
amp. and 4 volt
Battery at 1/2 amp.

A



Automatic, silent "A" Battery charging — Always on the job!



STERLING AUTOMATIC POWER CONTROL SWITCH

This device is used with any trickle charger, so that all power control is centralized in the filament switch of your panel—thus governing the operation of your eliminator, trickle charger and the set itself.

This instrument is included in the Sterling R-102 Trickle Charger.

R-105 Automatic Radio Power Control Switch, Price \$5.25.

THE Storage Battery, that is charged now and then, gradually loses power and reception begins to suffer. If, however, you put this noiseless trickle charger to work, your "A" Battery will be maintained at full efficiency all the time without your giving it a thought.

Equipped with combination switch controlling the "A" charging and radio reception, and indicator to prove that it is working correctly.

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The "Mountie" isn't lonely any more

WHEN the supply ship steams south from the last outpost of civilization in September, not to return until the following July, loneliness will never again beset the lives of the Royal Canadian Mounted Police who patrol that vast, wild area.

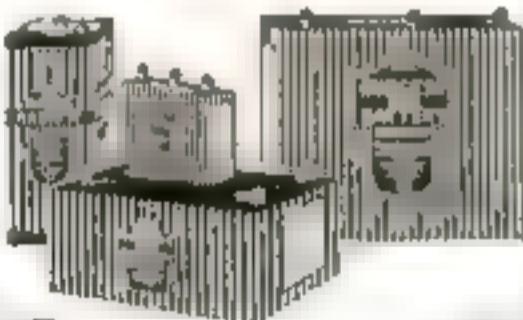
Radio is now brightening the long winter nights with music, special programs, messages and greetings from their "home folks."

And in the receiving sets of the "Mounties" is the best equipment obtainable. The batteries they use must be dependable. They must serve until new supplies are brought in a year later.

Ask any Radio Engineer

BURGESS BATTERY COMPANY
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RADIO BATTERIES

Twigs Used for Artistic Porch Flower Boxes

PORCH post boxes have long been a hobby of the writer's. I have tried to make them; did make them, elaborate ones. But that little spark of artistic feeling always condemned the finished product.

At last I found them—the boxes I wanted. They were, however, not the offspring of any of my inventive moments. They were made with fewer tools than I possessed and cost nothing. They were made of small twigs assembled in interlocking fashion as the photograph shows.—FRANK W. BENTLEY, JR.

Making Moisture-Proof Wooden Puzzles and Novelties

BLOCK puzzles, such as described in recent issues of POPULAR SCIENCE MONTHLY, are apt to fit together and come apart beautifully on a dry day, whereas on a wet day, no matter how well seasoned the wood is, the pieces cannot be pried apart.

If the wood is boiled in a mixture of one part beeswax and one part paraffin until it stops bubbling, and then allowed to cool until the wax starts to thicken, it will keep its size regardless of humidity. This process drives the moisture out of the wood and the wax penetrates right through. The blocks are cut to size after being treated in this way.—W. E. FREYRE.

Music Cabinet and Rack

A 1 in. strip doweled to the hinge edge to serve as a rail for holding music books when the top is elevated. Hang this section to the fixed top with two 1½ by 1½ in. fixed pin hinges mortised into the edges ¾ in. from the ends. Round off the upper corners of the top on ends and front to a radius of ½ in.

Around the sides and front nail a ½ by 1 in. square-edged strip, and flush with the top a ¾-in. quarter round molding, which may be planed from scraps. Screw on a short desk chain to prevent the top from folding back too far.

Cut the back panel 1 ft. 8 in. by 2 ft 3½ in., and nail into place.

Fit the door with a scant ½-in. clearance all around, beveling the edges a little toward the inside, and hang with 1½ by 2 in. loose pin bolts placed 5 in. from the top and 4 in. from the bottom. Center the knob on the height of the panel and the stile, and place a friction catch in the edge just above center.

Sponge the cabinet with a damp cloth to raise the grain, and sand glass smooth before applying the finish.



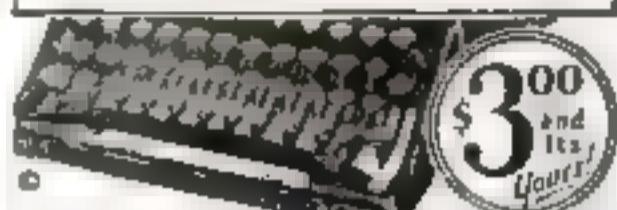
A beautiful rustic box for a flower pot

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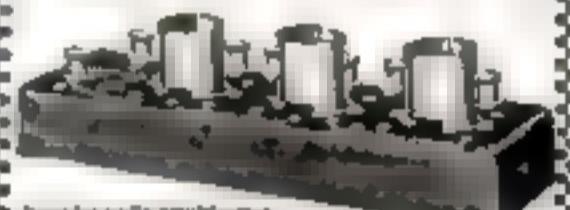
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PERFECT AUDIO AMPLIFIER



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require no medicine but effectively replace what is lacking or defective in the natural ear drums. They are simple devices, which the wearer easily fits into the ears where they are available. Soft, safe and comfortable. Writing for 100 page book on deafness giving full particulars and many illustrations.

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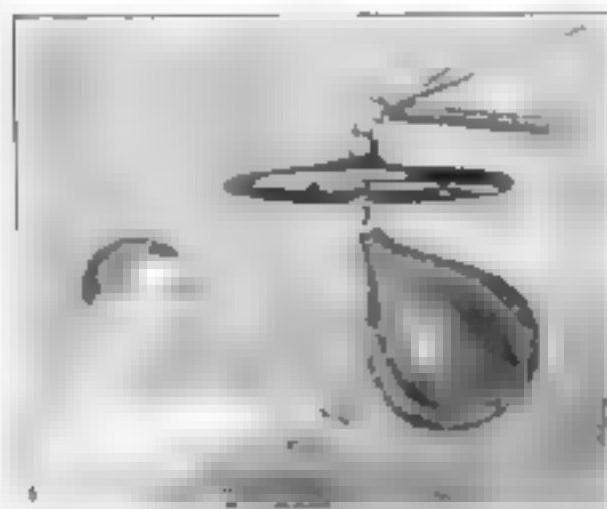
The Home Workshop**Auto Wheel Support
for Punching Bag**

By CECIL W. BEIL

BAG punching is enjoyable and healthful, but usually only those who have access to a gymnasium indulge in this exercise. That is partly because the old-fashioned type of punching bag support takes up too much room in the average home and is too noisy.

When mounted as illustrated, a bag requires very little space and is relatively noiseless. Furthermore, the support is made up almost entirely of materials that can be found around the workshop, except the auto steering wheel, and that can be obtained from any automobile salvage yard for little or nothing. It should be of the large type, which is about 13 in. in diameter, and the wooden rim must be in first class condition to stand the battering it will receive.

The arm can be made as shown from a length of 1-in. pipe with a flange at one end and an elbow at the other. The



Little room is required for this punching bag support and it is relatively noiseless

ell preferably should be of a so-called street elbow type, with internal threads at one end and external threads for entering the hub of the wheel—at the other.

The two braces are $\frac{1}{2}$ by $\frac{3}{8}$ in. iron, fastened to the arm by means of a $\frac{3}{8}$ -in. bolt through the ell. The arm and braces should be screwed or bolted first to a board, the board then is attached securely to the wall. A ceiling mount can be arranged similarly.

The hub of the wheel should be bored and tapped so that it can be screwed on the arm and so that it will take a short length of $\frac{3}{4}$ in. pipe underneath. To this extension the bag is to be fastened. It must project about $1\frac{1}{2}$ in. below the rim of the wheel. A hole should be drilled in the side of the pipe through which the rope can be threaded and tied. A wooden spool is driven in the end of the pipe to prevent the fraying of the rope, which may be $\frac{3}{4}$ -in. cotton cloth twine.

The wheel can be unscrewed readily from the arm and held in the hands somewhat like dumb-bells or a wand for performing various setting-up exercises. When not in use, it can be hung up against the wall out of the way.

**Bradleyohm-E
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This new oversize resistor is used as standard equipment by leading B-Eliminator manufacturers such as Acme, All-American, Majestic, Philadelphia Storage Battery and Willard. The scientifically-tuned discs provide stepless, noiseless, plate voltage control, and the setting will be maintained indefinitely.

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Fig. 1. Filing a duplicate pin tumbler key by clamping the blank and key together.

How to File Door Keys

By F. E. TUFTON and
RAY F. KARZUSCH

WHEN a duplicate door key is needed or a broken or lost key must be replaced, the handy man usually can find a blank key to fit the lock, if he knows how to go about it. Indeed, it is easy to file keys for the common tumbler locks (Fig. 2), and even make duplicate keys for pin tumbler locks when necessary (Fig. 1).

The tools needed are a vise, a few warding files, and frequently a hack saw and an awl. A 4-in flat warding bastard file (Fig. 4) is useful for cutting rectangular notches in the ordinary tumbler lock key as shown in Fig. 3, and the lozenge file, such as is used in the shop for sinking dies, is convenient for filing the V wards of a pin tumbler key.

In purchasing a blank key (Fig. 4) at a hardware store, choose one as nearly the size and shape

(Continued on page 110)

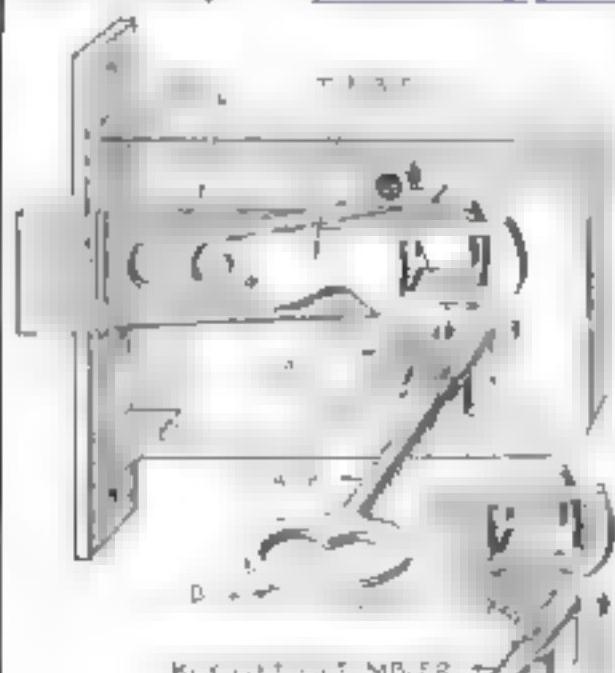


Fig. 2. A typical common door lock. The key raises the tumbler, then moves the bolt.

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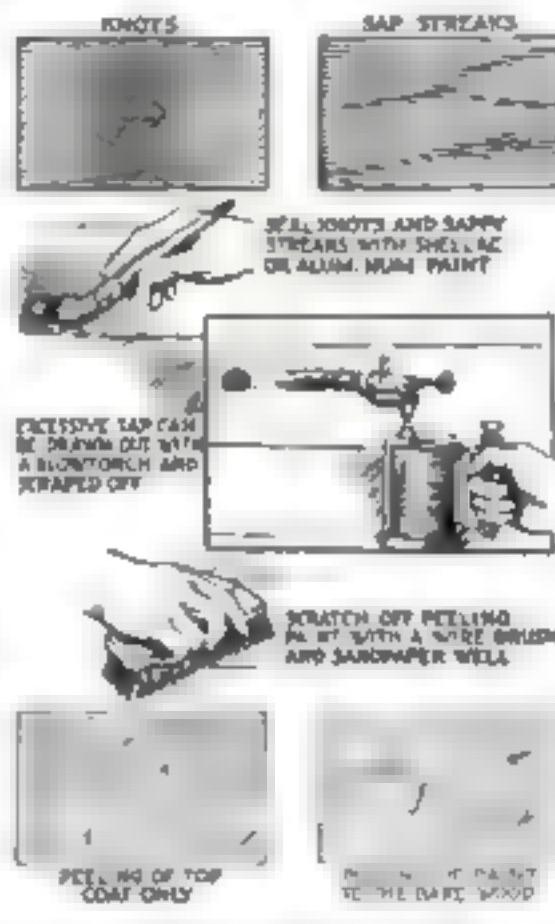
When You Paint

(Continued from page 101)

"I've noticed streaked and spotted discolorations on many buildings that have been painted only a short time. The job will look fine until these streaks begin to show up and spoil it. What makes them? You see them quite often."

"Well, I'll tell you. They are caused by painting over knots and sap streaks without first treating them or without treating them thoroughly enough. The heat from the sun draws the pitch out of the knots and sappy places and it comes through the paint coats and forms a dark colored mass."

"Knots and sap streaks should always be sealed over with shellac—preferably orange shellac—before the priming coat is applied. While many painters touch



up these spots with one coat of shellac, any unusual prevalence of pitch and sap stains makes it advisable to coat them over twice. Some painters favor the use of aluminum paint instead of shellac, considering it more effective as a sealer, and also desirable because it will completely hide any surface no matter how dark its color.

"Then there is a way to be even more sure that discoloration will not occur and it is really worth while. That is to go over with a painter's torch all knots and streaks that are excessively sap loaded. The heat draws the pitch to the surface and it can be scraped off with a putty knife. Then the spots should be sandpapered a little, and given two coats of shellac or aluminum."

"That's surely very simple—and inexpensive insurance against the spoilage of a fine appearing job," remarked Mrs. Andrews. "Now, tell me this: Why does paint peel?" (Continued on page 111)



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When You Paint —

(Continued from page 112)

You sometimes see it peeled off clear down to the bare wood, and then sometimes only in small scales or flakes that seem to be in the last coat."

"Now you've asked something of a question!" I responded. "There are a number of reasons why paint peels. The reason in any particular case can be determined only after a diagnosis of the symptoms. In the first place, peeling is generally caused by moisture. It may be moisture in incompletely seasoned lumber. It may be dampness on the surface from a rain, dew or frost shortly before painting. It may be moisture finding its way out from plastered walls that had not dried thoroughly before painting. Then it may be caused by painting over a sappy, resinous surface that has not been sealed up by shellac, or by painting over a greasy surface—anything that causes an imperfect attachment of paint to the surface.

"If the paint peels off clear to the wood, even in cases where the surface may have been repainted several times without previous trouble, the fault undoubtedly is in the first painting of the building. The original priming coat—the first coat—has not been adhering to the wood, although it has not heretofore broken loose and let go.

"If the coats separate and the last coat becomes detached from previous coatings, the fault is clearly in some faulty condition of the last painting. Sometimes the paint comes off in small scales or flakes. This is generally termed scaling, and sometimes results from insufficient linseed oil in the paint, which is, therefore, too brittle.

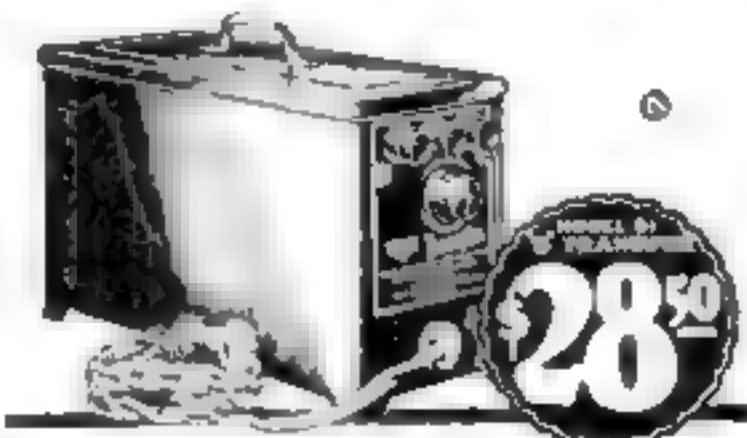
"While there are a number of reasons for the peeling of paint, you can be almost certain that it will not occur if no moisture is present at the time of painting, either in the wood, on the surface, or inside the house, if the surface is free from grease and dirt, if knots and sap streaks are sealed with shellac; and if there is a liberal amount of linseed oil and turpentine in the paint, especially in the priming coat.

"As to the remedy: When peeling occurs, all the loose coatings must be thoroughly removed. In many cases they can be scraped off with a wire brush. If too bad, they must be burned off with a painter's torch. Then repaint, being sure that properly prepared painting material is used under proper painting conditions, and, as a general thing, it will be better to use moderately thin coats."

Mrs. Andrews had more questions on outside painting but we decided to leave them for discussion another day.

This is the second of a series of articles by Mr. Elliot on the many points that spell either success or failure in painting jobs about the house. The next article, also on questions that arise in connection with outside painting, will appear in an early issue.

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WHEN all the lathes are busy, a rush turning or boring job often can be done on the milling machine, using the regular milling vice for holding the tools.

A glazed wheel will not cut properly and is likely to burn the work.

When a grinding wheel glazes there is something radically wrong about the way the job is being handled.

The wheel may be too hard or the feed may be too fine, or there may be too much oil in the grinding compound.

It does not pay to grumble about a hard job, it only makes the job doubly difficult.

Never use resin on a belt to prevent slipping, have the belt shortened or use a good belt dressing that will keep the leather soft and pliable.

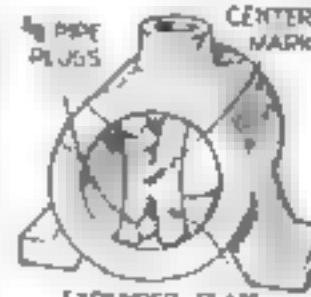
Always remember that the fellow who loses his head also loses the battle.

After setting up a heavy job on a planer, make sure that the work will clear the housings and pass under the cross rail, and also see that all bolts are tight before you start the machine.

It is not always safe to set the stroke on a planer while running; many men have been seriously injured while doing this. Play safe and stop the machine before shifting the trips.

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SHOPS assembling machinery frequently find it necessary to put a temporary center in the trunnion holes of journal boxes and similar parts. In place of driving a piece of wood into the hole, which is a common practice, one shop uses a $\frac{1}{2}$ -in. brass plate provided with expanding plugs. This is made to fit the size bores used in the special line of machines being manufactured. Once the center is located on the plate, it serves for all holes the same size. G. T. Lutes.



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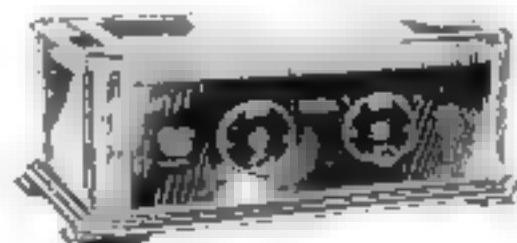
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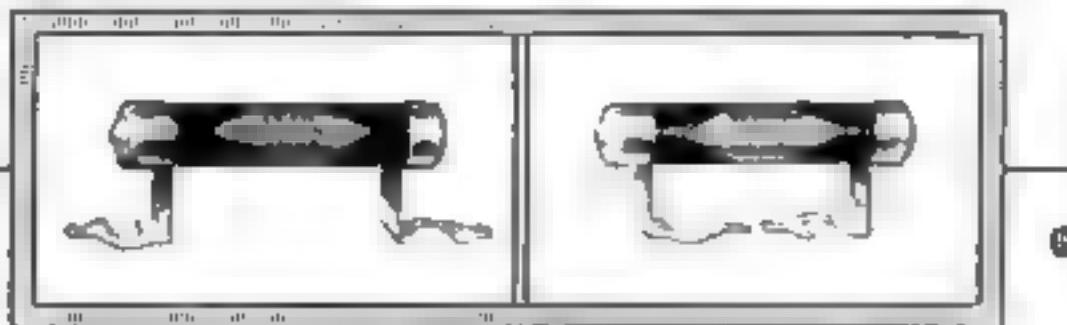
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Gauge Shop Methods

Tricks in Taper Reaming

(Continued from page 74)

and reamer will naturally follow the hole and you will have an imperfect job when you get through. I thought I explained that to you once before—you've got to have a truly generated hole to start with if you expect a good job. Look at this rough sketch I'm making (Fig. 9, at right). Here is a boring bar with a single point tool, which should be set to bore a size about one thirty second smaller than the small diameter of the hole. Then another tool, for coring a few thousandths under the small diameter. Next a roughing reamer, preferably with left hand spiral flutes, and a finishing reamer. Both these reamers should, of course, be held in floating holders. The only way to produce a true running hole is to generate it first with a single point boring tool. This is always your starting point for good work. Don't forget it!"

"I guess I'm a kind of a dub," Harvey said, somewhat mournfully, "I'm always doing something wrong, but it's

The diagram shows a cross-section of a bronze casting. It features a central vertical hole with two cutters (C and D) at the top. Below this, a roughing reamer (E) is shown, followed by a finishing reamer (F). The final result is a smooth, tapered hole.

Fig. 9. A bronze casting, which is first bored with a piloted boring bar having two cutters (C and D); and then reamed with roughing reamer E and finishing reamer F.

because I want to get the work done quickly."

"You want to think out your job before you do it; then you'll be all right," the engineer responded. "Now, here's another taper hole job"—pointing to a number of bronze castings just off one of the side tables. "These look like something requiring care. Are you going to machine these?"

"I guess Anderson will get that job, because that's his machine right over there," Harvey replied, "but I would like to know how to do it just the same."

"Here is a blueprint of the work and here are some new reamers that look as if they went with the job. Whoever made those reamers knew what he was doing—they are just what they should be for the work. Notice the long taper hole (A in Fig. 8). If I were going to do this job I would first chamfer the large end of the work (B). Then I should use a piloted boring bar with two cutters (C and D) to remove as much of the made scale as possible before reaming. Even if the boring bars removed considerable metal, the roughing reamer (E) would have a lot of work to do. That is why it has been made with tucks in the teeth."

(Continued on page 117)

This seal on a radio, tool or oil burner advertisement signifies the approval of the Institute of STANDARDS. See page 8.

Better Shop Methods

Tricks in Taper Reaming

(Continued from page 103)

"So it will cut easier?"

"Yes, it cuts easier because it breaks up the chips into smaller pieces. Then they are easier to get rid of and don't fill up the holes of the reamer so fast. The finishing reamer (F) is almost the same as the rougher except the teeth are not nicked. The reamers both have left-hand taper flutes and are not likely to chatter as they will not pull in. These reamers are held by the floating type and must be held in floating holders on the turret of the machine."

"I guess that material is pretty hard stuff to cut, Mr. Grimes. The tools will dull quickly, don't you think?"

"IT LOOKS like manganese bronze and if so, the operator should use a good supply of hard oil when cutting it or else his tools will not stand up. Sometimes boring bars and reamers used in long holes are provided with holes for lubricant. A hole is drilled longitudinally into the bar and then cross holes are put in to meet the one in the center so as to allow the lubricant to flow out at the points desired."

"We had a steel job a while ago," Harvey interrupted, "where we had to use an oil drift, but I have never seen a boring bar or a reamer rigged that way. It must be a nuisance to operate and I should think a man would have to wear a bathing suit."

"No, it's not at all bad, if properly arranged," replied Grimes. "It can be connected up with the regular oil piping on the turret of the machine and a stopcock arranged conveniently so the flow of oil can be controlled, or it can be done with a pipe through the spindle. The latter scheme is the better because the direction of the oil flow carries the chips forward and out of the work, they do not get back into the chuck and cause trouble."

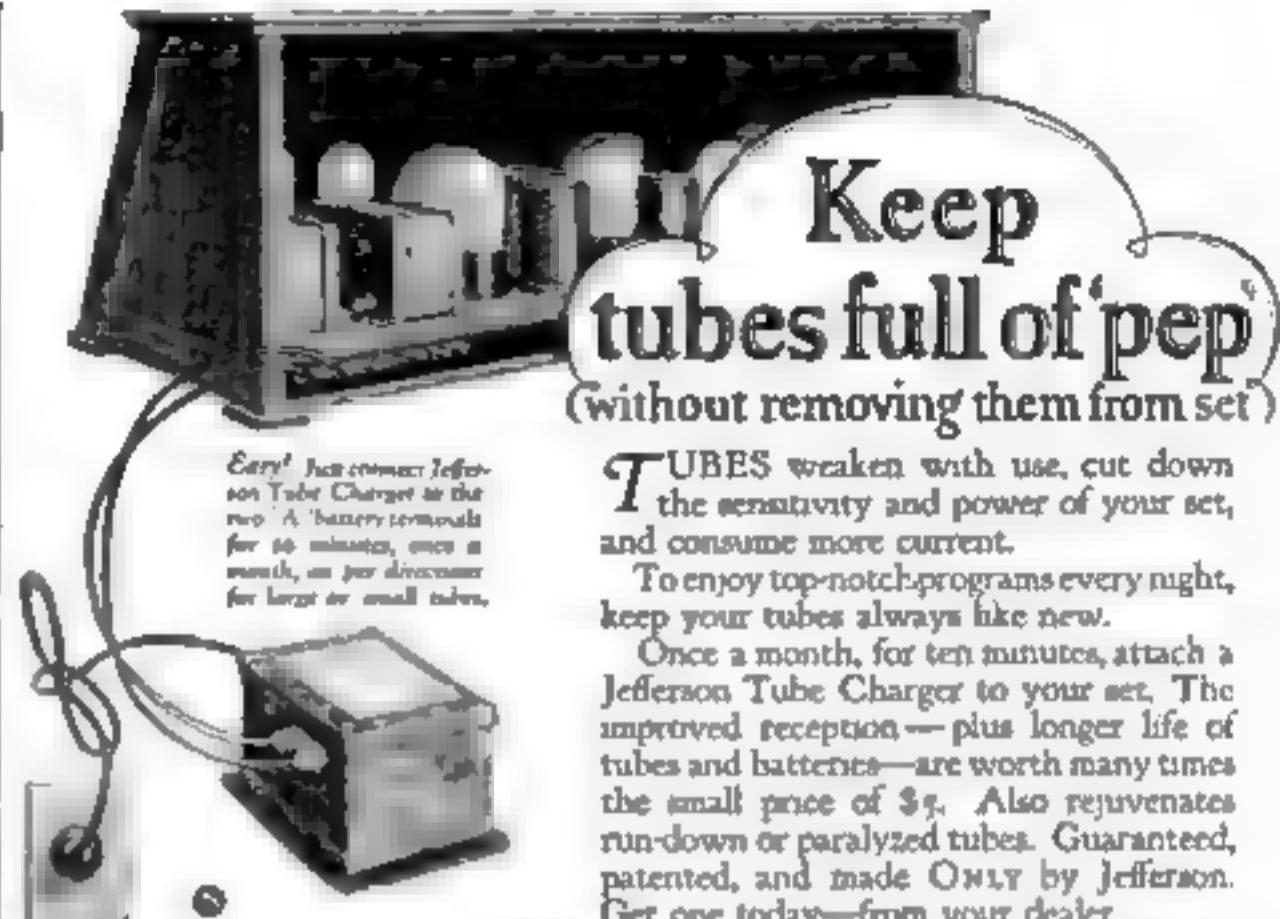
"I SUPPOSE that with this scheme," the young mechanist remarked, "you have some kind of a plug in the end of the pipe so the oil only flows after the pipe has entered the boring bar or reamer."

"Yes, a very simple arrangement. But do you realize that time is half over, and you will have to hurry if you don't want to miss your lunch."

"Good night!" exclaimed Harvey, as he glanced at the clock and hurried over to the bench for his lunch kit. "This efficiency stuff is bad dope when it makes a man forget his meals!"

This is the sixth in a series of articles by Mr. Dowd, who is one of the foremost authorities on machine shop methods. Another article of his will appear in an early issue.

Only the very best grade of oil or grease should be used to lubricate ball or roller bearings. Cheap oils are apt to injure highly polished surfaces.



Keep tubes full of pep (without removing them from set)

TUBES weaken with use, cut down the sensitivity and power of your set, and consume more current.

To enjoy top-notch programs every night, keep your tubes always like new.

Once a month, for ten minutes, attach a Jefferson Tube Charger to your set. The improved reception—plus longer life of tubes and batteries—are worth many times the small price of \$3. Also rejuvenates run-down or paralyzed tubes. Guaranteed, patented, and made ONLY by Jefferson. Get one today—from your dealer.

JEFFERSON ELECTRIC MFG. CO.
Largest manufacturers of small transformers
509 No. Green Street, Chicago
(PATENTED)

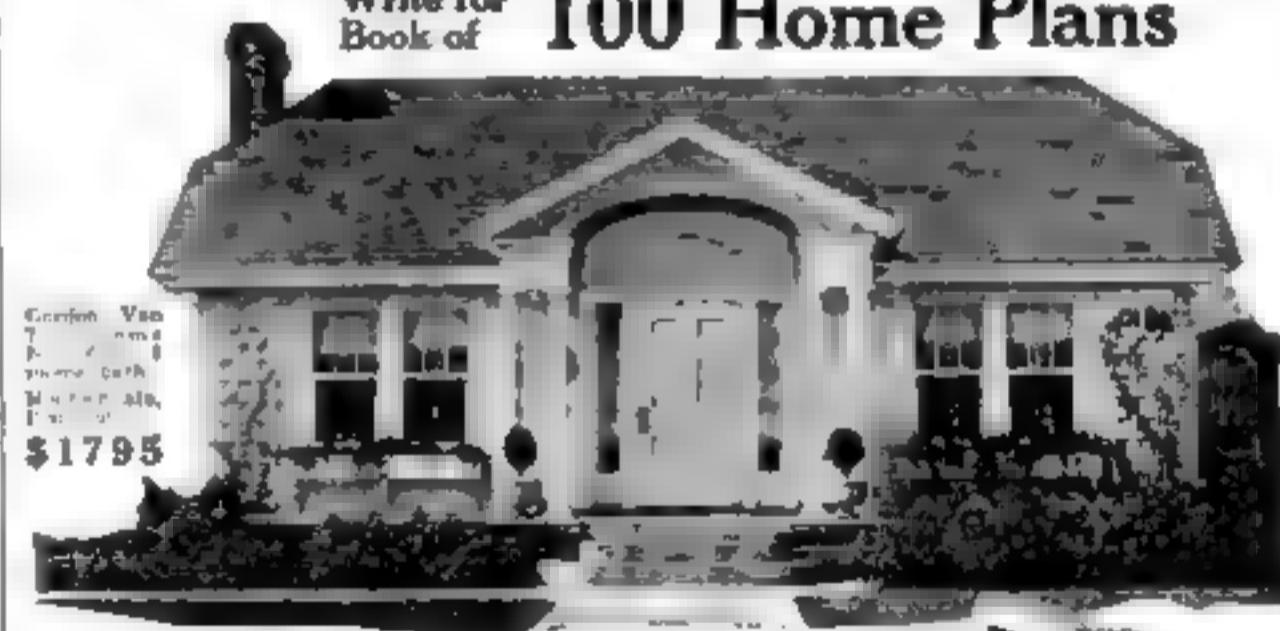
Jefferson No. 275 Tube Charger

Make More Money

Read the Money Making Opportunities on pages 125 to 159 of this issue.

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Tine Co.
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\$17.95

Down Comes Building Cost Through the Savings of Machine Sawing!

By the Gordon-Van-Tine Plan-Cut system we saw-cut and notch the lumber on the machine, saving time, labor and power. It saves at the point where time starts framing and raising of walls. You save on materials, labor and the cost of men in houses. And machine-accuracy insures the tightest, staunchest type of construction!

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Gross Profit. Rather
Cheatful, Poultry
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WET CELLARS MADE DRY from the Inside

DAIRY musty cellars are unsanitary, a danger to health and a poor place to store valuable material.

Where water or moisture seeps in through cracks or porous spots in the floor or walls, you can make and keep your cellar dry and sweet—a fit place to work, free from odor, mold and rust—by filling the cracks and coating the moist surface with Smooth-On No. 7.

This is the one practical waterproofing that you can apply yourself, easily, from the inside, to wet or dry surface and with every assurance of thorough watertightness, even in the wettest season.

Excellent also for patching concrete floors, waterproofing garage, stable and washroom floors, brick walls, cisterns, septic tanks, water troughs, fountains, fish ponds, swimming pools, manure pits, etc.



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Please send the free Smooth-On Reps' Book
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Bradley leak

THE PERFECT GRID LEAK

Provides a positive range of grid leak resistance from $\frac{1}{2}$ to 10 megohms. Assumes most effective grid leak resistance value for all tubes. Small grid condenser (0.00025 microfarad). Metal parts nickel plated. One hole mounting.

Allen-Bradley Co. ®
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393 Greenfield Avenue Milwaukee, Wis.

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Better Shop Methods

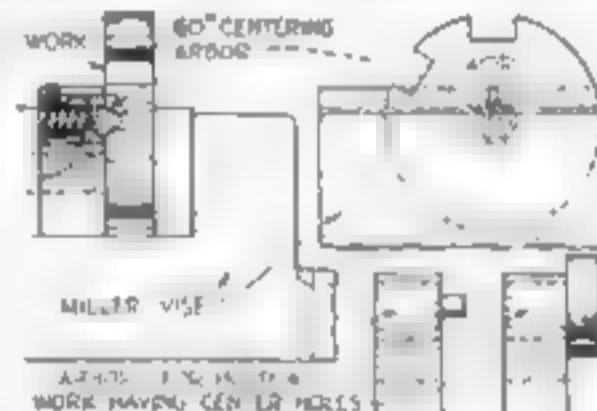
Centering Jaw for Miller Vise

By HENRY SIMON

THE vise jaw illustrated below was especially designed for use in the index slotting or milling of disk-shaped work. It possesses the advantage of being simple and of rigidly supporting the piece under the cut. It is adaptable to work having either centers or a central hole or recess.

The jaw consists of a block of cold rolled steel exactly similar to the regular jaw except for its greater thickness and somewhat greater height. Near its upper edge is bored a hole in which one of several centering devices can be located.

In the main view, the 60-deg. center is shown in use. This consists of a cylindrical body from $\frac{1}{8}$ to $\frac{1}{4}$ in. shorter than the thickness of the jaw, formed with a center in front and recessed behind for the re-



The work turns on a center or arbor carried in a special jaw that is made to fit the vise

ception of a very stiff coil spring. The center engages the hole in a free sliding fit and its movement is limited by a check screw extending into an annular groove formed in the center body and enough wider than the screw to allow the desired amount of play.

By means of this center, work may be located accurately and at the same time held in a full vise grip, thereby allowing the heaviest cuts to be taken. If it is desired, a pointer or indicator made of sheet metal may be mounted somewhere on the jaw as an aid in indexing.

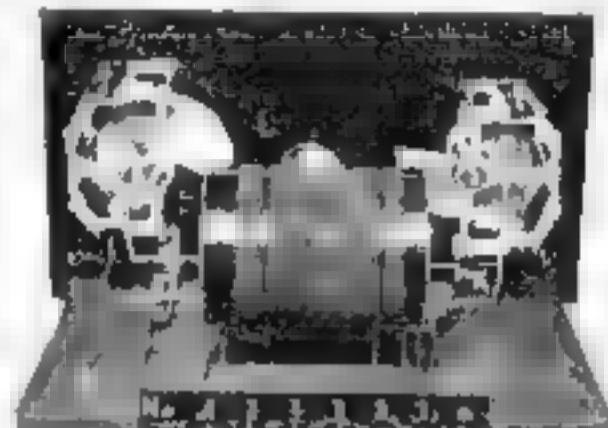
Where there is a hole or recess in the work instead of a center, arbors such as those shown separately can be easily made in a variety of diameters and quickly substituted for the center. All that is necessary to do this is to remove the check screw, when the center can be pulled out. The arbor can then be held against creeping by tightening the check screw lightly.

As the jaw is not otherwise greatly different from the standard, it can be left in the vise between indexing operations unless some job comes along which necessitates its removal.

Some mechanics know, some have forgotten, others, perhaps, have never known that an application of chalk upon a coarse file makes it cut more smoothly and uniformly.—G. D. H.

Make Your Own Radio Set

POPULAR SCIENCE MONTHLY publishes reliable blueprints of radio sets. These sets give excellent results and can be made by anyone who is handy with tools.



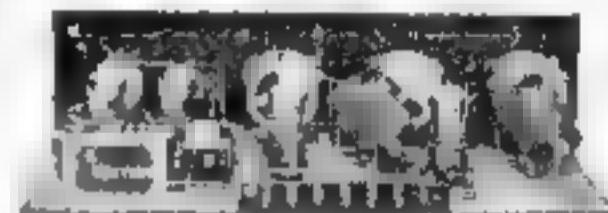
**One Tube Radio Set
Blueprint No. 41—Price, 25 cents**

Describes a simple, one-tube regenerative receiver of the fixed coil type. The regeneration is controlled by a variable condenser and does not affect the wavelength adjustment. Quality of reproduction is excellent because no audio frequency current flows through the tickler coil. The coil is hand wound and the rest of the parts can be of any standard make.



**Three-Stage Amplifier
Blueprint No. 42—Price, 25 cents**

Describes a three-stage audio amplifier to be added to one tube set of No. 41 to obtain loudspeaker results. Is equally useful with any other standard one-tube detector circuit. Consists of one stage of transformer coupling, followed by two stages of resonance coupling. Volume control is simple and does not affect quality of reproduction. This blueprint does not describe a radio receiver—it is simply an audio amplifier to be used in connection with a one-tube radio receiver.



**Four Tube Radio Receiver
Blueprint No. 43—Price, 25 cents**

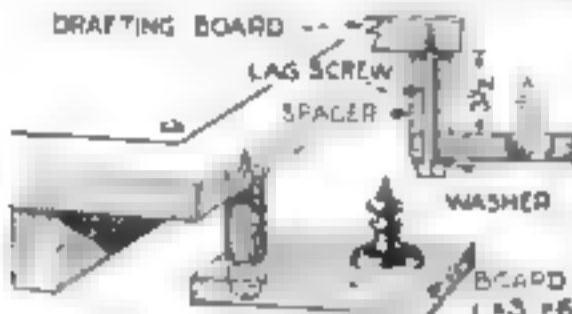
Describes a four-tube radio receiver consisting of one stage of radio frequency amplification, a regenerative detector, and two stages of transformer coupled audio amplification. It gives the greatest power for distance and volume that is obtainable from four tubes. Easy to build, uses any standard parts except the coils, which are simple to wind by hand. Two control tuning and regeneration does not affect wavelength adjustment.

POPULAR SCIENCE MONTHLY
250 Fourth Avenue New York City

Better Shop Methods**Convenient Holder for Drawing Ink Bottle**

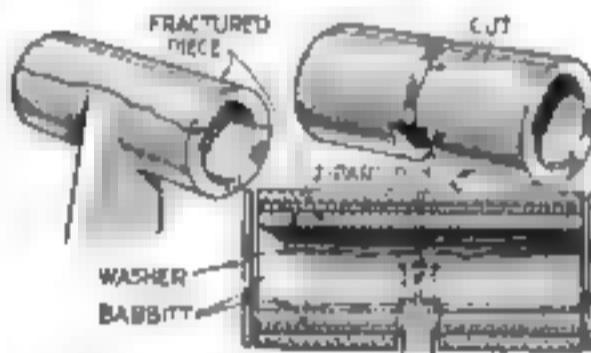
ALTHOUGH many styles of commercial ink bottle holders are available for the drafting table, I have used for years a homemade one of the type illustrated.

A hole is bored in a piece of wood 1 by 3 by 6 in. to receive the bottle. The holder



The bottle rests in a block fastened so that it can swing underneath the drawing board

then is attached beneath the drafting board by means of a lag screw, which passes through a wooden spacer. Two washers are placed as shown so that the holder will swing smoothly.—A. D. D.

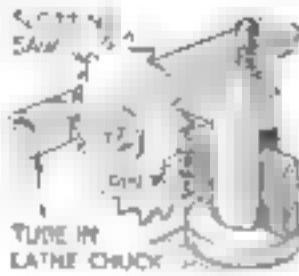
Pipe Sleeve and Babbitt Used to Repair Broken Hub

How the broken hub was reinforced with a casing made of steel pipe and Babbitt metal

THIS particular hub happened to be on a horizontal boring machine, but there are similar brackets on printing, woodworking, and other machinery, so the method of repair shown should be generally useful. In place of welding the break, which would have necessitated the re-aligning and re-babbing of the bearing, a pipe sleeve was made in two parts to surround the hub. Washers were clamped on the ends, and babbitt poured to bind the parts.—G. L.

Multiple Edged Parting Tool for Light Brass Tubing

A C H E A P
A s e c u r e -
slotting saw at-
tached to a holder
by means of a
small bolt solved
one cutting-off
tool problem
economically. The
job involved the
cutting off of thin
brass tubing. When one tooth of the
saw became dull or broke, another was
used. This trick is useful only when the
tube wall is thin.—R. H. KASPER



For cutting tubes

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CATALOG CONTAINS OVER 2000 ITEMS, from the most beautiful, fully equipped console radio set, down to the smallest part or tool for the set builder—kits, parts and supplies of every type and style. All beautifully illustrated and interestingly described. Also valuable data of today's most fascinating and most wonderful achievement—**RADIO.**

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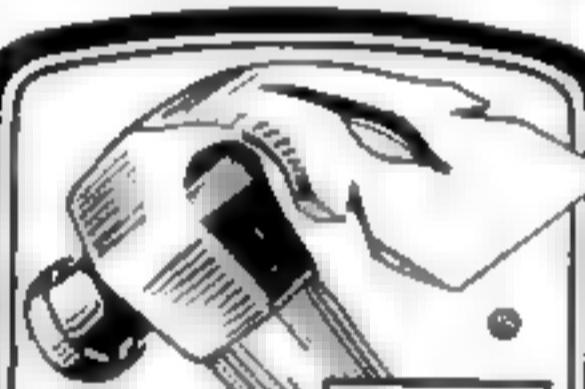
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Advice for Popular Science readers regarding safe and profitable investments. See page 6.

A 2c Stamp

will start you on the road to success. See Money Making Opportunities on pages 128 to 159.

**A Claw-Hammer and Cutting Tool in One**

THE chiseled edge on the end of the claw makes this hammer a cutting tool of a hundred uses, without altering the claw feature. Small side claws make it easy to pull nails in close corners. The off-set position of the nose gives far greater leverage—pulling ten-penny nails with ease. A perfectly balanced one-pound hammer forged of tool steel. If your dealer cannot supply you write us direct.

Price \$2.00



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H. A. Ayer—Dept. E.
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**Abraham Lincoln and the Harmonica**

On one of his journeys for a debate with Douglas, Abraham Lincoln picked out of his pocket a little harmonica and played upon it, seeming to get happiness in the playing thereon. Says Carl Sandburg in "Lincoln, The Prairie Years": "Someone remarked about his playing on the harmonica and he said: 'This is my band; Douglas had a brass band with him in Peoria, but this will do for me.'"

Back to the days when Abraham Lincoln was engaged in his world-famous debates with Stephen A. Douglas, the Hohner factories were engaged in making "The World's Best" Harmonicas. Today, Hohner Harmonicas are available at leading dealers the world over. Ask for the Free Instruction Book, M. Hohner, Inc., Dept. 182, 114 East 16th St., New York City.

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Dr.
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Even sleight-of-hand, generally supposed to require long practice, is NOW made simple to learn. For Dr. Harlan Tarbell, one of the really Great Magicians, has finally opened up the secrets of his profession in a completely illustrated course offered at a merely nominal cost. Through the wonderful Tarbell System you will be able to mystify and entertain your friends with simple tricks taught in your very first lesson. After that Dr. Harlan Tarbell takes you through the entire mass of sleight-of-hand, card tricks and elaborate stage diversions. The apparently superhuman doings of the accomplished magician becomes as simple as ABC when you just know how.

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Tell me all about Dr. Tarbell's new and simple system by which I can learn the secrets of MAGIC. No obligation on my part.

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Better Shop Methods

Old Bill Shows How to Measure "Fits"

By JAMES ELLIS

DISGUST replaced the smiling expression on Roscoe's face as he hunted for a file. The customer, who was waiting for a pulley he had just bushed, was nervously pacing the floor near-by. Soon Old Bill would be out wanting to know if the next job was ready!

But there could be no mistake about it: the bushing Roscoe had pressed into the pulley was too small in the hole, and must be filed out before an unfriendly audience. At noon the next day the boys would josh him about it. The game isn't worth while, he thought.

Old Bill came out at length, and saw the difficulty, noted the annoyance of the



"You have let yourself in for a good kidding," Old Bill remarked, with a kindly smile.

waiting customer, and observed from the corner of his eye the grins the other machinists were exchanging.

When at last the unlucky pulley had been fitted to its shaft, the disconsolate Roscoe turned his attention to the next job. Old Bill gave him a few instructions and then added, with his usual kindly smile, "You have let yourself in for a good kidding at the hands of the boys!"

"I know it," Roscoe admitted.

"Well, the next time you have something like that bushing to do, show them that you can do it right the first time. You got along very well until it came to making the press fit. The running fit in the hole was good, for I saw you try the bushing on the shaft, but you allowed too much on the outside, which made the bearing close up. It is usual to allow one thousandth of an inch to every inch of diameter for a pressed fit, but if it is a bushing or a fragile hub, you cannot leave so much."

"On your bushing you should not have allowed anything, but should have made the two parts what we used to call 'iron and iron,' which means that both the hole and the shaft, or bushing, are exactly the same size, or as nearly so as we can make them."

"To get fits like that you will have to cultivate a very

(Continued on page 121)

CARTER "Midget" Rheostat



50c

Self-cooling
All Metal
Frame

Cast Zinc

No moulded parts to crack or break. Resistance element is clamped in place and held tight. It cannot move and short circuit. Smallest Rheostat made. All resistances including R.M.A. Standards.

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CARTERS RADIOS
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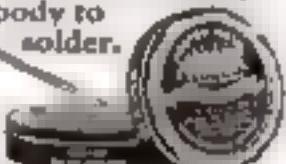
A touch and it's done

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is heat—and Kester Metal Mender. It's ready to use and with it you can do your own soldering at home as well as an expert. Full directions with each can, enables anybody to solder.



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**Make Things at Home
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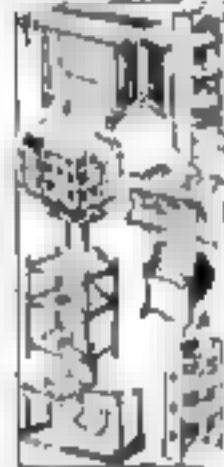
A compact and efficient electric work shop driven by the famous SpeedWay motor. Equipped with

Eight Motor Driven Tools

Gives you a complete Lathe, Bench Saw, Jig Saw, Portable Electric Hand Saw. A portable or stationary power drill, equipped for drilling, grooving and cleaning. Attach the Speed Way Motor to any light socket and you have a completely equipped tool and machine shop.

Only \$10.00 Down

A small down payment balanced in easy monthly payments, puts one of these efficient machine shops in your own house.



10 Days' Free Trial
Our free trial plan enables you to test out the shop in your own home. If it does less than we claim for it send it back.

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With this shop you can make attractive furniture, picture frames, toys, household articles, counter—other useful pieces.

Don't Delay— Write Today

Write for full information on the SpeedWay Shop. The shop is a money maker for the small job man and fun for the man who makes things at home. Write today.

Free Blue Prints
Write for 164 of working blue prints that will teach you with much speed how to build.

Electro-Magnetic Tool Company
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Manager, Dept. 62. Please send me particulars about 10-day free trial from blue-prints and \$10 down payment.

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Address _____

More than HUMAN

The only automatic self-adjusting filament Control, supplying at all times just the current your tubes require. Insures long tube performance. Safeguards against damage. Eliminates hand rheostats. Simplifies wiring. Insures on Amperite. Refuse substitutes claimed just as good. Price \$1.10 complete.

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Write
Dept. P.R.S.
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Hook-Ups

AMPERITE
The "SELF-ADJUSTING" RHEOSTAT

SPORT BODIES for FORDS
at FACTORY PRICES!

This model
costs \$39.50
Made for Roadster
4 1/2" wheeling Other
models.

SPORT FACTORIES, Aurora, Illinois

Mysteries of the Viking Trail

(Continued from page 15)

he reached Alaska, starting with both sloops being nearly wrecked, his ill luck began. He sailed south, but the jinx pursued him, and he put into Botany Bay sick and discouraged. Twenty-one men had been drowned, twelve had been slaughtered by natives, and his long boats had been lost. In a dispatch to France he stated that he was making a run to the Friendly Islands, after refitting his ships.

That was the last communication ever received from La Pérouse. His two ships sailed out of the Bay and vanished as if they had been whisked into another world.

Because of the French Revolution, it was three years before an attempt was made to search for La Pérouse. Then two vessels were fitted out and embarked on the hunt. For two years the expedition cruised the South Pacific, meeting with the worst fortune imaginable. It encountered trouble with the natives; suffered the ravages of disease and famine, both commanders died; and finally the crew ended up as prisoners and the ships as the spoils of the Dutch, with whom war had broken out.

IT WAS forty years later that what is possibly the true story of La Pérouse's doom came to light. Peter Dillon, while anchored off Tucopia, a small island of the New Hebrides, was attracted by a silver sword guard carried by a native whom he had befriended. On closer inspection he thought he could discern the initials of La Pérouse engraved upon it. He was informed by the native that many like articles were in the possession of the natives of Vanikoro, and that they had come from two ships which had been wrecked there years before. Dillon at once decided to sail for the island and rescue such of the crew as might survive. But again the nemesis of La Pérouse descended: Dillon's ship became leaky; his food spoiled; and he was becalmed for days. After much hardship, he put into Calcutta, where he reported his findings to the Bengal Government.

THE East India Company lost no time. Dillon was immediately put in command of the Research for the purpose of conducting an expedition to Vanikoro in quest of the missing Frenchmen. But no sooner had Dillon received his commission than he learned that the company, in which he had his entire fortune invested, had failed, leaving him penniless; and from the date of her sailing the Research was bedeviled. The chief officer became inebriate; the clerk deserted with the ship's money; the crew mutinied, and many of them jumped ship. It was only through pure luck that the vessel ever reached Vanikoro at all.

Once on the island, axes, knives, and silver forks were found in the hands of the inhabitants, and this is the story which was told to Dillon. According to the natives, many years before two ships had been driven ashore by a hurricane and wrecked. The crew of one of the vessels had been massacred by the savages, to the

last man. But the men from the other boat, more tactful, had managed to gain the confidence of the natives and were allowed to land in safety. The survivors lived on the island for a time, while they constructed a sloop from the wreckage, in which most of them sailed away. Those who remained had long since died.

Such was the story. It seems to solve the mystery of the lost ships of La Pérouse, although it is not conclusive.

Even more puzzling is the mystery of the *Mary Celeste* (wrongly and often called the *Maria Celeste*) over which men have wracked their brains for fifty years.

IT STARTS in December, 1872, when Captain Boyce of the *Dei Gratia* sighted off the coast of Gibraltar a brig running aimlessly before the wind, apparently sailing itself. The captain's telescope disclosed the name, *Mary Celeste*, but not a man on deck. When his repeated signals went unanswered, Boyce ordered the lowering of a boat, and the strange ship was boarded.

Cautiously the captain led his party through the vessel, suspecting mutiny, and watching for treachery at every step. He was at last forced to believe what his eyes told him—there was not a soul aboard. The ship was sound and in as good condition as if she were fully manned; not a thing was out of place; there was nothing to suggest that life on the boat had been interrupted—save that there was no life.

The cargo was in perfect condition. Food and water were in abundance. Clothing remained in the sailors' chests, undisturbed. The cash box had not been molested. Nowhere was there a sign of a struggle or of any disturbance whatever. And the ship's boat hung on its davits! How, unless the crew had been sucked into the sky, had the ship been abandoned?

ENTRIES had been made in the log of the *Mary Celeste* up until ten days before she was salvaged by Captain Boyce. During that time she had kept to her course and covered a distance of more than 400 miles—unmoored—which is unbelievable. It has been suggested that someone remained on the ship for several days after the last entry was made, and that is most probable.

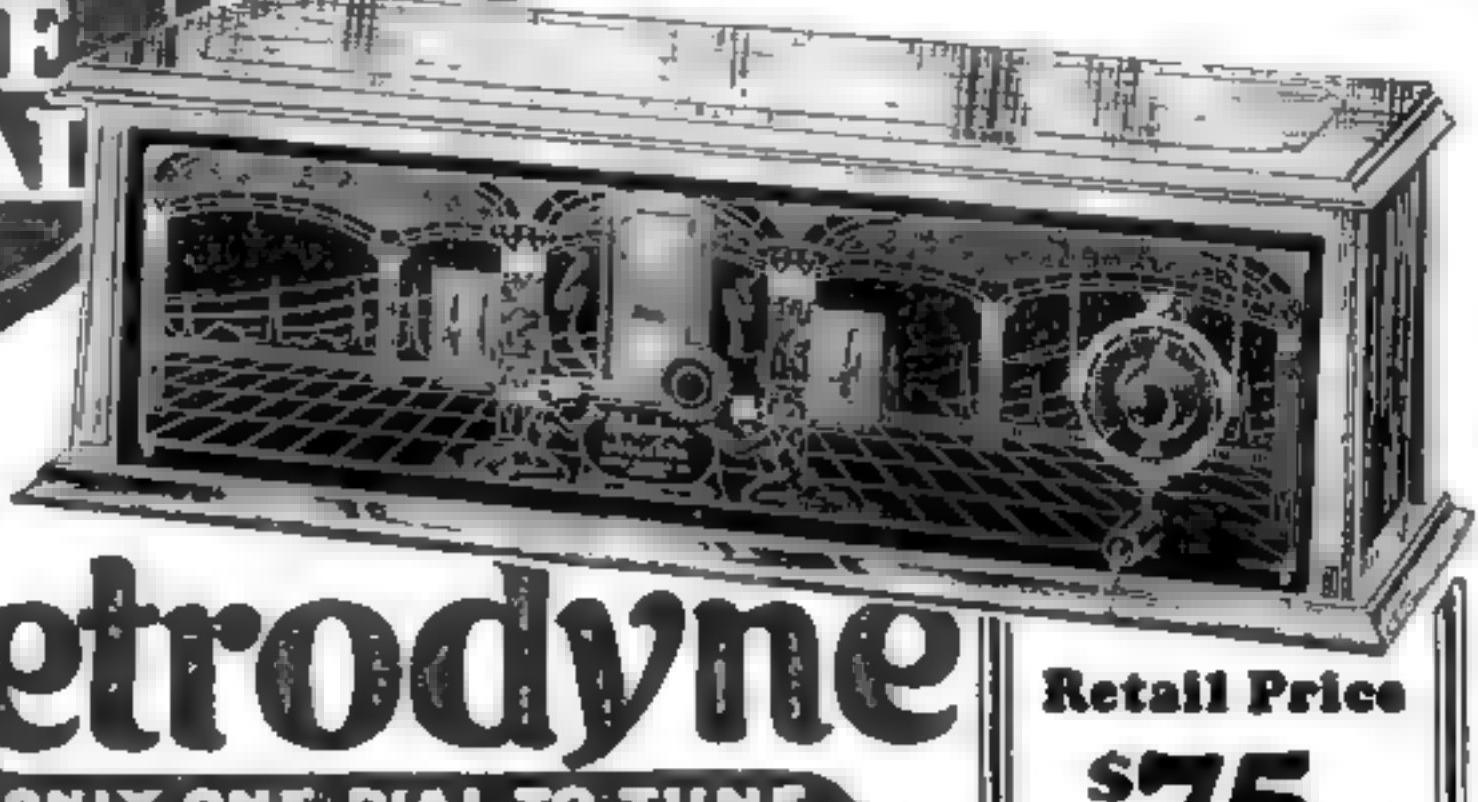
This only we are sure of: The *Mary Celeste* left New York for Gibraltar carrying ten persons, including Captain Briggs, his wife and daughter, and the crew. It bore a cargo of alcohol. It was found derelict near Gibraltar, in perfect condition, without a living soul on board.

There has never been a more perfect mystery. Not one word was ever received from any of the crew, nor has any theory yet been advanced which explains with satisfaction the reason for the abandonment or the manner in which the ship was deserted. There have been rumors and traditions and legends galore. There have been explanations, both ridiculous and ingenious, but not one of them has stood up under investigation.



7 Tube Set Single Dial Radio

The
Metrodyne
ONLY ONE DIAL TO TUNE.



Retail Price

\$75

Completely Assembled

*Big Discounts
to Agents and Dealers*

Wonderful Offer Direct from the Factory!

A perfect working, single dial control, 7 tube receiver. And just to prove our claims, we will ship it to your home or **30 days' free trial**. Test it under all conditions. Test it for distance, volume and local quality—and if you are not convinced that it is the best single dial set you ever heard, return it to the factory. We don't want your money unless you are completely satisfied.

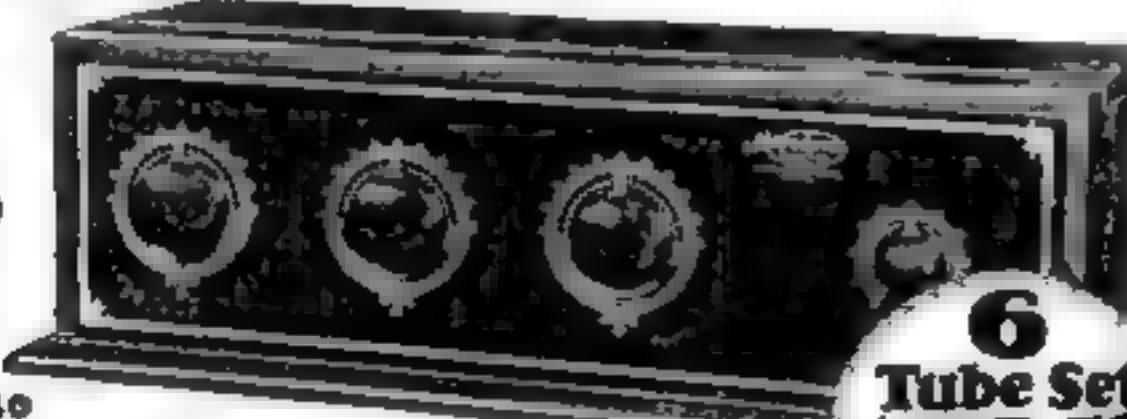
BIG PROFITS TO AGENTS AND DEALERS

Our Agents and Dealers make big money selling Metrodyne Sets. You can work all or part time. Demonstrate the superiority of Metrodynes right in your home. Metrodyne Radios have no competition. Lower wholesale prices. Demonstrating set on **30 days' free trial**. Greatest money-making opportunity. Send coupon below—or a letter—for our agent's proposition.

Metrodyne Super-Seven Radio

A single dial control, 7 tube, tuned radio frequency set. Approved by America's leading radio engineers. Designed and built by radio experts. Only the highest quality low loss parts are used. Magnificent, two-tone walnut cabinet. Artistically gilded genuine Bakelite panel, nickelated piano hinge and cover support. All exposed metal parts are beautifully finished in 24-k gold.

An easy set to operate. Only one small knob tunes in all stations. The dial is electrically lighted so that you can jog stations in the dark. The volume control regulates the reception from a faint whisper to thunderous volume, 1,000 to 3,000 miles on loud speaker! The Metrodyne Super-Seven is a beautiful and efficient receiver and we are so sure that you will be delighted with it, that we make this liberal **30 days' free trial offer**. You to be the judge.



**30
Days' FREE Trial**

Metrodyne Super-Six

Another triumph in radio. Here's the new 1927 model Metrodyne Super-Six. The 6 tubes are approved by the U. S. Bureau of Standards. A loss of 10% in power. A better radio at less price. Super-Six is a real radio expert. Easy to tune. Complete. The radio can be tuned instantly on same dial readings every time. No guessing.

Mr. Howard, of Chicago, said: "While the Chicago broadcasting stations were on, he ate. I tuned to seventeen out-of-town stations, including New York and San Francisco, on my loud speaker horn, very loud and clear, all thought they were all in Chicago."

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal **30 days' free trial offer**, which gives you the opportunity of trying before buying.

**6
Tube Set
\$48.50**
RETAIL PRICE
Completely
Assembled

MAIL THIS
COUPON
or send a postal or letter for our
proposition before buying a radio
Deal direct with manufacturer—
Save Money.

Mail COUPON Below!

Let us send you proof of
Metrodyne quality

F. L. Wierman, Greenfield, Ind., writes: "I received the Metrodyne 6 tube set and am much pleased with it. Got stations 7,000 miles away."

G. J. Warner, Marquette, Calif., writes: "Received my Metrodyne Radio (the set #1-X). I believe that these are the sets are going to be excellent sellers. I had an trouble in tuning in stations enough to satisfy anyone, so you will please send me another set."

Ray Black, New Franklin, Calif., writes: "Very often we travel from New York to the Hawaiian Islands quite frequently and to do this, it is means of the 6 tube electrically lighted dial. The Metrodyne Single Disc Set is much easier to operate than any radio set I've ever seen."

We will send you hundreds of similar letters from owners who acclaim the Metrodyne as the greatest radio set in the world. A postal letter or the coupon brings complete information, testimonials, wholesale prices, and our liberal **30 days' free trial offer**.

METRO ELECTRIC COMPANY
2161-71 N. California Ave., Dept. 152
Chicago, Illinois

Gentlemen:

Send me full particulars about Metrodyne 6 tube and 7 tube sets and your **30 days' free trial offer**.

Name _____

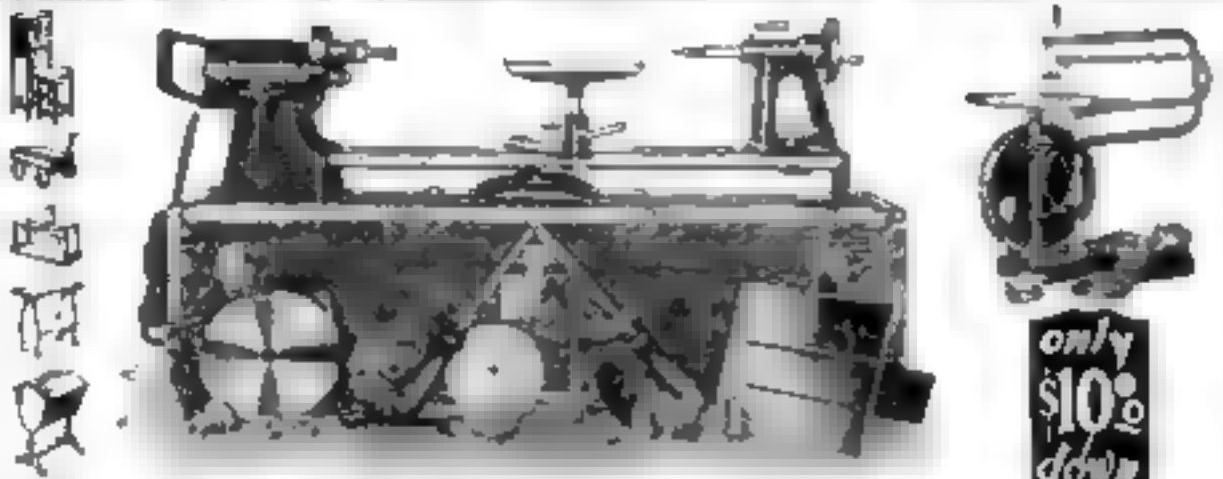
Address _____

If you are interested in AGENTS prop-
osition, place an "X" in the square

METRO ELECTRIC COMPANY
2161-71 N. California Ave. • Dept. 152 • Chicago, Illinois

© This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

NOW! MAKE THINGS AT HOME WITH THE NEW **RED JACKET** HOME WORK SHOP



only
\$10.⁰⁰
down

THE HOME CRAFTSMAN'S LATHE

A chest full of the old tools that make you an accomplished workman. Designed for a man or for the private use of tool boxes and men who want to build, construct, repair and create a better. You will be able to make everything after you odd furniture and home and garden, repairing all around metalworking and more.

BUY ON YOUR OWN TERMS

Only \$10.00 Down. Liberal Cash Discounts
Third and Twenty Payment Plans.

SPECIAL CRAFTS COURSE

FREE TO OWNERS

Everything Explained in our
catalogue. Ask for it. It's FREE. Write

free
BLUE
PRINTS

Complete equipment consists of the powerful Red Jacket Model with direct drive by the distinctive wind driving belt. Capacity 10 in. x 72 in. a bench on a stool and 140 rpm. and all accessories of both portable and stationary power driving, drilling, grinding and sharpening. Additions to 100% market, etc., from a complete garage tool and machine shop.

Genuine Electric
TOOLS NOT A-TOY!
Created for home, shop, farm, transport, exhibits and educational purposes never equaled any job in it and no experience that any one can gain. An exceptionally good tool. Our laboratory is constantly at work, inventing and improving everything for today. Learn all about the Red Jacket Home Work Shop now.

WACO TOOL WORKS, 2014 So. Wabash Ave.
Chicago, Illinois
Manager Dept. 2. Please send me particulars about
10-day free trial, free blue-prints and \$10 down payment.

Name _____

Address _____



Don't let unruly hair spoil that shot!

SHOOT!

Score tied! Two minutes to go! Then—a lightning dribble down the floor, a sudden turn, and—

"Make that basket!" . . .

At times like this your hair won't get in your eyes if you use—Stacomb. And at times when you want your hair to look its best—smooth, lustrous, in perfect order . . .

To make unruly hair lie down more firmly rely on Stacomb than any other dressing for the hair!

And here's the secret—no matter how stubborn your hair is, Stacomb keeps it in place, right—all day long.

And more!—Stacomb never leaves your hair sticky nor gummy. Not dry and "dead," as wetting with water leaves it. Stacomb supplies the oils your hair needs. Helps to prevent dandruff.

Stacomb comes as a creaming cream—in jars and tubes—and now in the popular new liquid form as well. All drug and department stores.

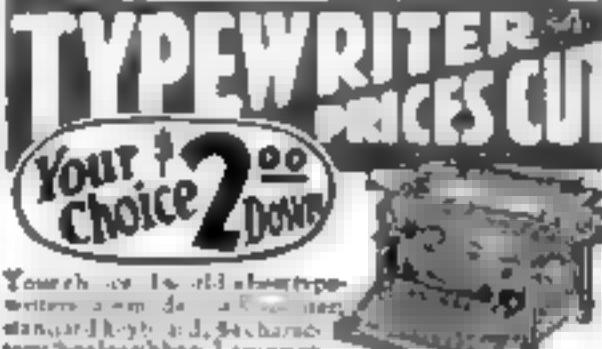
FREE
OFFER

Stacomb

Standard Laboratories, Inc.
Dept. EBC-4 113 W. 14th Street, New York

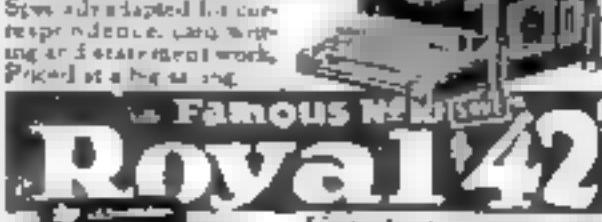
Send me free sample of Stacomb as checked:
Original, cream form New Liquid Form

Address _____



Your choice **2⁰⁰** down

Touch the old short-type
writer and do a few lines
and try it. Standard
two-color ribbon. Low price.



10 Days' Free Trial. All new models, completely rebuilt and relinished brand new. Guaranteed 20 years. Just send for our big free catalog showing several machines in full color. Also our direct-to-you easy payment plan and special 10-day Free trial offer. No obligation. Write today.

INTER NATIONAL TYPEWRITER EXCHANGE
200 West Lake Street [Dept. Z-2] Chicago, Ill.

Peering under the Earth's Crust

(Continued from page 40)

Atoms are the little giants of science. Their average diameter is about one ten-millionth to one hundred millionth of a centimeter, and a centimeter is a third of an inch. These tiny particles dart about like shooting stars. Each atom is like a miniature solar system, having a nucleus, like a planet, and electrons like satellites about it.

What a "bunch" of atoms looks like may be illustrated by a cluster of wooden balls, each having three flats upon it, permitting the balls to cling together in a formation resembling a bunch of grapes. This is Sir William Bragg's means of demonstrating the atoms of bismuth crystal. In crystals the molecules are more closely attached to one another than in gases and liquids. In gases they move to and fro independently, while in liquids they are always in touch with one another, though clinging partially.

How to Breathe

Exercise 4. Stand erect, holding stick (broomstick is ideal) across the front of the thighs, hands about a yard apart. Inhale slowly, raising the stick with straight arms up in front, over the head and down in back until it rests across the buttocks. Exhale slowly, at the same time returning the stick to the starting position. Repeat five times and bring the hands nearer together on the stick as the chest and shoulder muscles become more flexible.

In this exercise the mechanical stretching from without and the complete lung expansion from within are especially efficient in stretching, limbering and raising the upper chest and expanding the upper part of the lungs.

Exercise 5. Stand erect, arms held horizontally at the sides. Bend forward at the hips, knees straight, at the same time exhaling and bringing the arms forward to touch the toes with the finger-tips. From this position rise slowly to the upright, inhaling slowly and bringing the arms out again to the horizontal position, at the same time tensing the muscles of the lower and upper back and forcing the arms as far back as possible. Repeat five times.

The skeleton, while it supports the muscles, must in turn be bound together and held erect by the very muscles it supports. This exercise develops an upright spine and erect shoulders.

Exercise 6. Lie flat on the back, legs straight. Lift the legs a few inches from the floor, at the same time inhaling deeply and slowly in the chest, using the diaphragm as little as possible and expanding the ribs as much as possible. Exhale slowly. Repeat five times.

This final exercise develops the strength and coordination of the muscles between the ribs so that they can operate regularly.

Note: Mr. McGovern will be glad to furnish free a chart containing a comprehensive exercise system if you will write to him in care of this magazine, enclosing a stamped addressed envelope.

To Men Getting Bald I Say!

No matter how fast your hair is falling out—no matter how much of it is already gone—I make this amazing guarantee! I'll end dandruff—stop falling hair—grow new hair in 30 days—or you don't pay me a cent! No strings attached! No "Ifs," "Ands" or "Maybes"! New hair or no pay! And you are the sole judge!



By ALOIS MERKE
Founder of the Merke Institute, 5th Avenue, New York

SAVE yourself from baldness! Stop falling hair! Grasp this "no risk" offer to grow new healthy hair in 30 days.

Here's My Contract

If your hair is rapidly falling out—if your appearance is spoiled by approaching baldness—if you have tried countless expensive hair treatments unsuccessfully—it makes no difference. My contract stands! I'll grow new hair in thirty days—or the trial costs you NOTHING.

Here's My Secret

Years of training and research and day after day experience in treating thousands of cases of loss of hair at the famous Merke Institute, Fifth Avenue, N. Y., have taught me many valuable facts about the hair—and this, the most amazing of all—that in most cases of baldness the hair roots are not dead, but merely dormant—asleep!

You're wasting your time—you're throwing away money—when you try to reach these dormant roots with ordinary hair tonics, oils, massages and saunas. For such meas-

ures treat only the surface skin and never get to the roots, the real source of trouble. How could they ever possibly grow new hair?

My Method Reaches the Roots

It's no use trying to make a tree grow by rubbing "growing fluid" on the bark. You must get to the roots.

And that's just why my scientific treatment is so tremendously beneficial! It penetrates below the surface of the scalp. It quickly reaches the cause of the trouble—the dormant starving hair roots. It awakens them. Hair begins to sprout again. It takes on new life and color. It becomes stronger and thicker. And in a surprisingly short time—sooner than you ever imagined possible—you have a new healthy growth of hair—OR I

PAY ALL THE COSTS OF THE TREATMENT MYSELF

And best of all, my system is so simple that it can be used in any home where there is electricity without the slightest discomfort—and for just a few cents a day!

New Hair or No Cost

Thousands claim seeming miracles for my treatment. I don't. I admit some cases of loss of hair are hopeless. Only remember this—these cases are so very rare and so many hundreds of others

have regained luxuriant hair through my method, that I am willing to let you try it for 30 days—**AT MY RISK**.

Then if you are not absolutely delighted—say so. And I'll mail you a check immediately—refunding every cent of your money and the treatment will have cost you **NOTHING**!

Free Booklet Tells All

The very fact that you have read this announcement shows that you are anxious about the condition of your hair, so why not investigate? Find out for yourself. If you will merely fill in and mail the coupon I will gladly send you without cost or obligation a wonderfully interesting booklet, which describes in detail my successful system, which is growing new hair for thousands all over the country. In addition it tells all about my iron-clad guarantee which enables you

to take my treatment without a penny's risk. Clip and mail the coupon today. **Allied Merke Institutes, Inc., Dept. 172, 512 Fifth Ave., New York.**

**Allied Merke Institutes, Inc.
Dept. 172, 512 Fifth Avenue,
New York City**

Please send me without cost or obligation a copy of your book, **The New Way to Grow Hair**, describing the Merke System.

Name _____

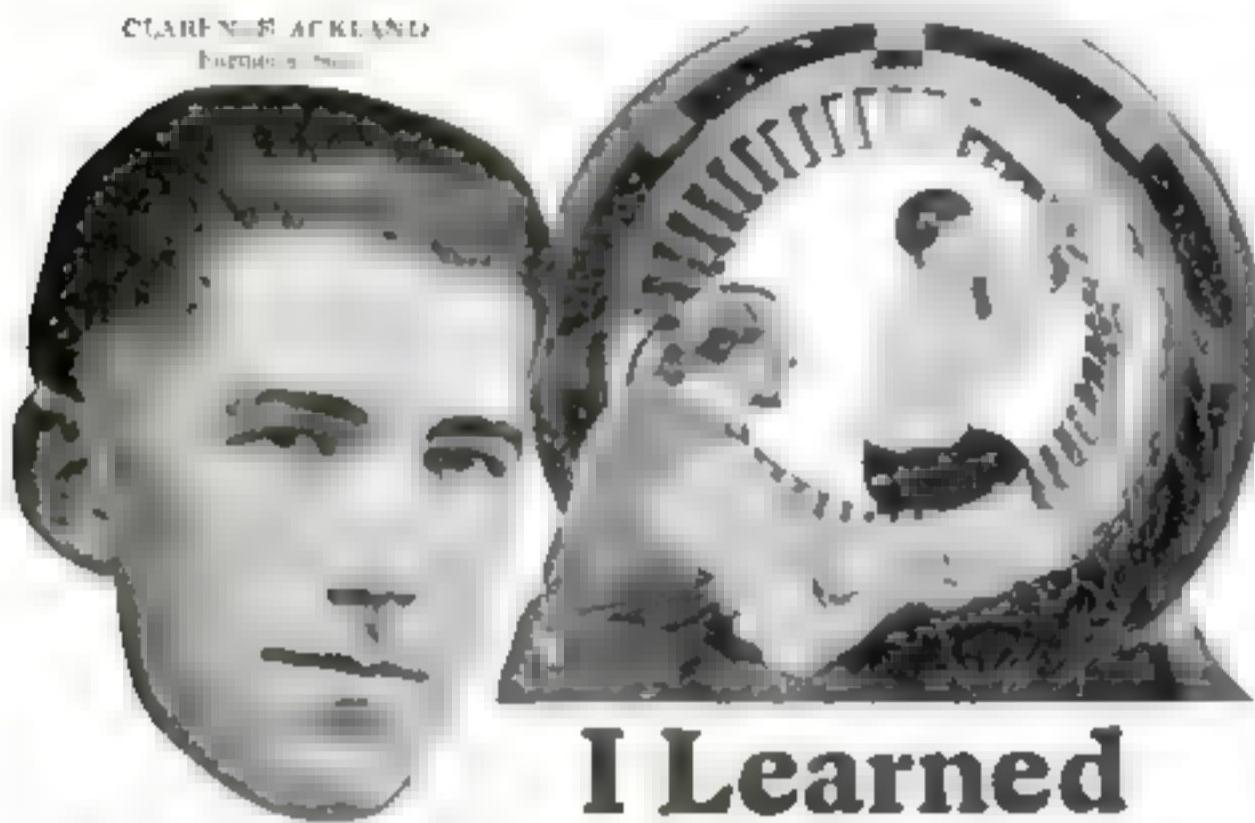
Address _____

City _____

State _____

Money Making Opportunities for Readers of Popular Science Monthly

CLARENCE ACKLAND
Farmer's Son



I Learned **ELECTRICITY** *Without Books or Lessons In 90 Days*

"Today I am making more money than ever before in my life. Many days I have made as high as \$25 clear." That's what Clarence Ackland, farmer's son, does in Wt. Brooklyn, Ill., in just evenings and spare time. Coyne electrical training has brought steady jobs, big money, and spectacular success to thousands. No matter what your age, schooling, experience or job is now, investigate the amazing opportunities open to you.

See How Quick You Can Earn \$60 to \$200 a Week

90 days—a mighty short time. But in those brief 12 weeks, Coyne training can make you a master of electricity. We couldn't begin to do it with books or printed lessons. We couldn't hope to do it by correspondence. We bring you to Chicago with free railroad fare, meals & room to a part-time job and we teach you in the great shops of Coyne—in radio dynamics, generators, power plants, autos, engines, batteries, lights, heat, etc.—the greatest outlet of electrical apparatus ever assembled.

NOT By Correspondence

There—and nowhere else in the world—can you get such training. There we can give you years of actual experience in 90 days. There, we can teach you far more than an ordinary electrician ever knows.

A Job? Don't worry about a job after training. Over 100,000 skilled electricians are needed every year. Our employment bureau secures dozens of positions every week! We give you free employment service for life and back you for life thru' our well organized graduate department.

And Pay? Boys not old enough to vote step into steady jobs paying \$60 and \$100 a week.

Coyne men have thousands of opportunities to make \$2,000 to \$5,000 a year.

H. C. LEWIS, Pres.

COYNE

ELECTRICAL SCHOOL
Sept. 27-28, 1936, 1300 W. Harrison St., Chicago
20th Year—Founded, 1916

Free R. R. Fare-Free Radio and Auto Electrical Courses—If You Enroll Now
Coyne gives you great chance to get into electricity. You don't need a spark of experience. You don't need high school education. R. R. fare to Chicago is free when you earn it. And we help you to participate while training. We have removed every obstacle. And right now I am including FREE Automobile Electricity and Radio courses.

If you really want more money. If you want a real future for yourself or your family, this is your hour of opportunity. You can find out many big opportunities free. Simply mail coupon for the big free Coyne Book of 150 photographs. Large opportunities.

This step does not obligate you. So act at once.

**Send for This
FREE BOOK
of Amazing
Opportunities**

Mr. H. C. Lewis, Pres.
Coyne Electrical School, Dept. 27-28,
1300 W. Harrison St., Chicago.

Dear Mr. Lewis:

No initial obligation, send me your big free catalog and all details. I understand I will not be bothered by salesmen.

Name _____

Address _____

City _____

State _____

TRUE STORIES OF SUCCESS

Whether you want to be an electrical engineer or a salesman, an auto mechanic or an accountant—whatever your ambitions you will find an advertiser in this section who can help you.

Like thousands and thousands of other readers of POPULAR SCIENCE MONTHLY he found the answer to his problem through one of the schools advertising in this magazine. Not only is Mike Kellner learning a profession that will mean a greatly increased income but, before he has completed his studies, he has "earned enough in spare time money to pay for three courses." Following is Mr. Kellner's letter which wins the first prize of \$10 this month.

Contest Editor:

The advertisement that interests me most in the Money Making Opportunities Section is the L. L. Cooke School of Electricity operated by Chicago Engineering Works because electricity offers man a great opportunity. A skilled electrical expert will earn as much money or even more than any other trade. It takes daring men to work on some of the high-tension lines. The Chicago Engineering Works is a large institution, and they have their courses up-to-date. They have a consultation service which enables any man to find out some of the various troubles which are not easily found. This is all free with the course I have been taking in this course for a year ago am about through with it.

I have earned enough of spare time money to pay for three courses. Before I took up the course I looked through the POPULAR SCIENCE MONTHLY for a good course and I think I got a very good course when I picked L. L. Cooke's.

Yours truly,
Mike Kellner,
New Stanton, Pa.

The man who feels that his greatest chance of success lies in selling people will be interested in the success story of a relative of Mrs. W. L. Grubbs who found his money-making opportunity through the National Salesmen's Training Association. From \$125 a month, seven months of the year job, to as high as \$125 on a single exceptionally good day in the story told in the letter which won the second prize of \$5.

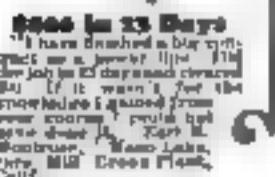
You, too, can achieve as big a success as either of the men whose true stories are told above. Whatever your ambitions you will find in pages 128 to 159 of this magazine the advertising of schools and publishers that will help you. Go through the advertising columns of this Money-Making Opportunities Section and write today to those advertisers who you believe can help you most. It puts you under no obligation—and a year from now you may be writing success letters like those quoted. (Continued on page 129)



6476 a MONTH
Dear Chief, I was brought
to you because you are successful
and your income over amounts
to about \$4,500 a month.
Before I took your
course I never made
over \$500 a month. I am
now Wittenberg, 1630
Grand Concourse, Bronx,
New York.



see a DAY
Mr. Cooke, I didn't
know a thing about Electricity
when I went there
so poor I had to leave
home. I was getting \$10.00
a day as a farm hand.
Now I make over \$1000
a day more than twice
what I used to do.
Thank you for my
success. Edward Lohmeyer,
Mill Market, the
United States.



You Fellows who want ***Big Pay***

Picture Him As He Once Was: Wages, \$15 a week, profession or trade none education, out of that of a grammar school. It would seem that the new things in it are for him were hard work, small pay and an uncertain future.

Now See Him Eight Months Later: He has become master of a trade, he has a business of his own, his net income is almost \$500 a month. He is looked up to in his community respected and there are still greater things in store for him.

Cooke Training Did It!

"Who is this fellow?" you ask. "What does he do?" He is Herman Wittenberg, 1630 Grand Concourse, Bronx, New York City an Electrical Expert. But his name makes no difference. It could be Ed Lohmeyer, Earl Montrose, John Wright or—You. It could be any one of thousands who have mastered Electricity the Cooke Way.

For Cooke-trained men know what it means to win success—to receive big pay envelopes, large incomes, important executive positions. They are Electrical Experts—know this fascinating profession as the lawyer knows law, as the doctor knows medicine.

AN UNCROWDED BIG PAY FIELD

Think what it would mean to you to be an Electrical expert in Cooke-trained men. Why you'd be running a high-pay job—anywhere where you're being paid! For in a right-sizeable field, a big, well-paying salary where you're equipped to be recognized and rewarded when the time comes. Of Cooke-Trained Men over \$1,000 to \$10,000 a year.

A fine education isn't necessary. Simplified Cooke Training has 44 lessons—the first is free and given Work Shop and J. D. Frost Method of Chief Engineer Cooke. And training fits in your spare time—at home—with free Job Work just fit to help you. Every step is made easier. Before you know it you'll be making real money doing special work. And then the next step is a permanent HIGH-PAY job—he kind you often dreamt about but never dared think could be yours.

Send for FREE Book— on ELECTRICITY

This big valuable 64-page illustrated book prepared by Chief Engineer Cooke shows the way to Big Pay. It describes the famous Cooke Method of training men, tells how electricians can be mastered easily and briefly. A valuable opportunity now exists for you in this big vital industry—see, today open the door to success. The book is gratis—no obligation, extremely interesting. The **SECRET WAY TO BIG PAY**. Send for it today. Mail the coupon to:

**L. L. Cooke, Chief Engineer,
L. L. COOKE SCHOOL OF
ELECTRICITY**

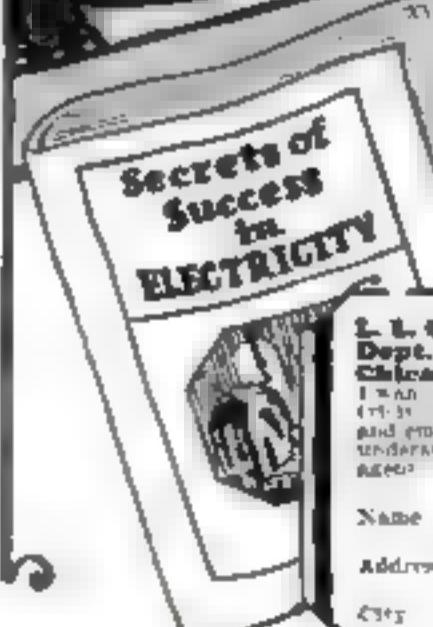
*Owned and Operated by the
Chicago Engineering Works, Inc.,
Chicago*

copy

see in 22 Days
I have drafted a big sum
of money. I want to get
the job in Chicago and started
you if it wasn't for the
knowledge I gained from
your course. Please
send me a copy of
the book. Name _____
Address _____ City _____ State _____

Here's an

Opportunity To Learn to Earn **\$3,500 to \$10,000 a year—and More**



L. L. Cooke
Chief Engineer
Electricity
"Electrical Wizard"

L. L. Cooke, Chief Engineer
Dept. 32, 2150 Lawrence Ave.,
Chicago, Illinois.

Please send me your free book on Electricity and a brief information regarding your training and opportunities so I can decide for myself. I understand this is to be sent me by mail and by air mail.

Name _____

Address _____

City _____

State _____

The Cooke Trained Man is the Big Pay Man

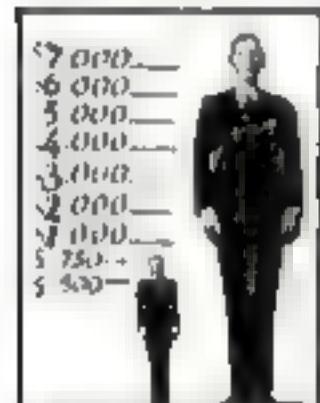


NOW FREE!

*Modern Salesmanship
1927*

Raised My Pay 700%

This Book Showed Me How



\$1,000 a year! And all of them started by reading this free book!

The Secret of Big Earnings

Many of the successful men in the world today are salesmen—salesmen. And every man is a salesman. If you want to make big earnings, you must learn to sell yourself. You must always be the author of saying just doing things that make men act as you want them to act. There is no such thing as success made than the old saw about advertising men born out people. Beliefs are made—not born! This free book shows how!

Big Demand for Master Salesmen

Master Salesmen are at a premium in American business today. They are never out of work. They can command their own salaries and their own time. They travel and see the country—the world. They draw well. Men in the best homes, drive their own cars. Aren't these rewards worth going after?

How We Help You Succeed

For nearly twenty years, N. S. T. A. training has been developing Master Salesmen. The National Demonstrator Method—an exclusive feature—gives you the equivalent of actual experience while studying at home. Our service is training inexperienced men into powerful salesmen in no time—and thousands of leading business houses have called on us to supply them with salesmen. This service is free—and we have placed thousands of men in good-paying positions.

Send for This Free Book

Don't say I can't tell until you find out whether you can or not. This free book, "Modern Salesmanship," proves that master salesmen can be made regardless of personality, education or previous selling experience. Send for this free book right now.

NATIONAL SALESMEN'S TRAINING ASSOCIATION
NATIONAL SALES TRAINING ASSOCIATION
Dept. H-15, N. S. T. A. Building, Chicago, Ill.

National Salesmen's Training Association
Dept. H-15, N. S. T. A. Building, Chicago, Ill.

Broaden your free illustrated book, "Modern Salesmanship." Also tell me how your training can increase my income. This does not obligate me.

Name _____
Address _____
City _____ State _____
Age _____ Occupation _____

True Stories of Success

\$25 in CASH PRIZES

For the best letter of 170 words or less answering the question—

"What advertisement in the 'Money-Making Opportunities' Section interests you most—and why?"

we will pay on March 10th the following—

CASH PRIZES

First Prize	\$10.00
Second Prize	5.00
Third Prize	3.00
Seven Prizes of \$1.00 Each	7.00

First read every advertisement in the Money-Making Opportunities Section on pages 128 to 159. Pick out the one that interests you most and then write a letter—not exceeding 170 words—telling us why you find the advertisement you have selected the most interesting.

Entry for the contest will close on February 1st. The prize winners and their letters will be published in the April issue of POPULAR SCIENCE MONTHLY.

Address your letter to

Contest Editor

MONEY-MAKING OPPORTUNITIES
POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York

PRIZE WINNERS

In the December Contest

FIRST PRIZE \$10.00

Mike Kellner, New Stanton, Pa.
(Chicago Engineering Works)

SECOND PRIZE \$5.00

Mrs. W. L. Grubbs, Sheffield, Ala.
(National Salesmen's Training Assoc.)

THIRD PRIZE \$3.00

E. C. Greene, Gallipolis, Ohio
(LaSalle Business University)

PRIZE WINNERS who receive \$1.00 each for their letters:

Gustav Thib, Eureka, So. Dak.
(Brightman Auto Parts Co.)

R. J. Hubbard, Strawberry, Ark.
(Washington School of Cartooning)

Parker T. Rushford,
New Martinsville, W. Va.
(International Correspondence Schools)

Frank A. Schneider, Wheeling, W. Va.
(Columbia University)

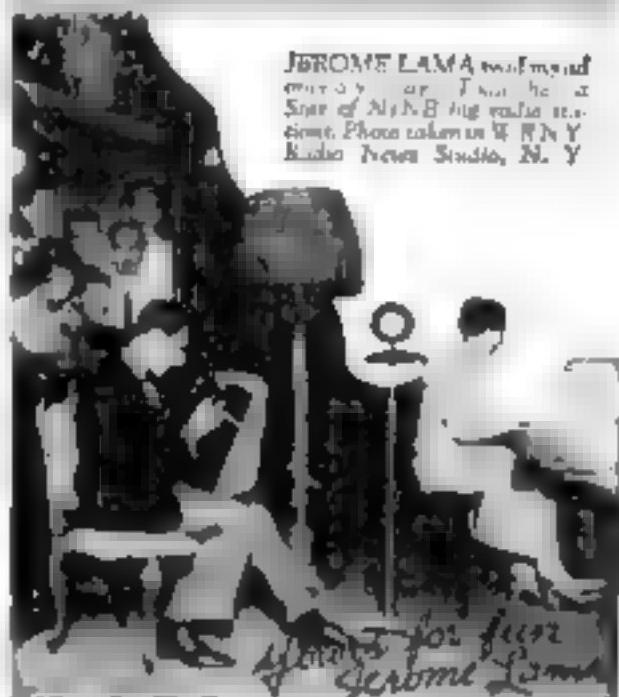
Frank G. Davis, Springfield, Ohio
(National Poultry Institute)

Clara Jones, Hedgesville, W. Va.
(American School)

Mrs. A. R. Graham, Moline, Ill.
(Turbell System, Inc.)

I'll teach you in 24 hours

Music, from a SAW!



JEROME LAMA, well-known country star, has been a Star of WLIB big radio station. Photo taken in WNY Radio News Studio, N. Y.

Once a Machinist—Now a Stage Star!

A YEAR ago Jerome Lama was a machinist in New York. Tonight, in full stage suit, he will entertain thousands, to thunderous applause. Labor has changed to pleasure. Pleasure brings fame and fortune. One Radio Station WLIB, WOR, WNYC, WGN, WRNY, WOKO, WMCA, WEAM, and WEI, millions have heard Mr. Lama.

Mysterious music is his secret. You could believe it is a violin, but it is a MUSICAL SAW. Anyone can do it. In 24 hours, you can play with unbelievable precision. Then quickly learn the latest jazz and song hits, operatic and classical music. Follow crowd around, curious and wondering, for it is a musical miracle.

5 DAYS' FREE TRIAL

To prove how quickly you can learn, I will send you for 5 days' trial, an exact duplicate of my Musical Saw, special tempered that I made for Mr. Lama. No music to read, no theory practice, no musical knowledge needed. Just three short simple lessons reveal every secret of success.

Startling Popularity—Big Money

Thousands have already learned—mystifying and fascinating their friends, invited everywhere, achieving instant popularity, opening the way to professional success. Let me tell you about these delighted, money-making Saw Musicians whose music rivals the violin. Let me prove that you, too, can quickly play like a professional. Write me today. Play at the next party!

MUSSEL & WESTPHAL
212 West Water Street, Fort Atkinson, Wis.



Quick Action Advertising

Adding Machines

JOHN H. RICE, Manufacturer, 401 W. 14th Street, New York, is interested in all kinds of business opportunities. Address him at 401 W. 14th Street, New York, or 1000 Peachtree Street, Atlanta, Georgia.

Advertising Services

ADVERTISING—100,000 copies should be distributed in New York, Chicago, Boston, Philadelphia, and San Francisco. Write to 1000 Peachtree Street, Atlanta, Georgia.

ADVERTISING—Star and News, a wire service for news, features, and information available throughout the country. Write to 1000 Peachtree Street, Atlanta, Georgia.

ADVERTISING—A full line of advertising services, including advertising, public relations, and promotional materials. Write to 1000 Peachtree Street, Atlanta, Georgia.

ADVERTISING—General advertising services. Write to 1000 Peachtree Street, Atlanta, Georgia.

Authors and Manuscripts

ADVERTISING—The firm has a well established organization of 100,000 copyholders throughout the country. Write to 1000 Peachtree Street, Atlanta, Georgia.

ADVERTISING—Books, periodicals, and other publications. Write to 1000 Peachtree Street, Atlanta, Georgia.

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Automobiles and Accessories

ADVERTISING—Business opportunities. Write to 1000 Peachtree Street, Atlanta, Georgia.

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Avgation

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Flowers and Landscaping

AVGATION—An organization of 100,000 copyholders throughout the country. Write to 1000 Peachtree Street, Atlanta, Georgia.

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BOOKS AND PERIODICALS—Manufacturing and distribution of books and periodicals. Write to 1000 Peachtree Street, Atlanta, Georgia.

Branch Offices

CINCINNATI—Atlanta, \$2.00. Forwarded daily.

Business Opportunities

BUSINESS OPPORTUNITIES—All kinds. Gold and silver coins, gold and silver Money Box Guaranty Co., Inc., Money Box Manufacturers, Ltd., Mountain, Florida, Alabama.

BUSINESS OPPORTUNITIES—All kinds. Gold and silver coins, gold and silver Money Box Guaranty Co., Inc., Money Box Manufacturers, Ltd., Mountain, Florida, Alabama.

Business Opportunities—Row 30 Cents a Word. A 10% discount is allowed on all contracts for six consecutive months. Advertisements intended for the April, 1937 issue should be received by Feb. 5th.

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Business Opportunities—Row 30 Cents a Word. A 10% discount is allowed on all contracts for six consecutive months. Advertisements intended for the April, 1937 issue should be received by Feb. 5th.

Direct to Smokers—Cigarettes

DIRECT TO SMOKERS—Cigarettes or cigarette holder packages of 20 cigarettes. Write to 1000 Peachtree Street, Atlanta, Georgia.

Distributors Wanted

DISTRIBUTORS—We want to sell our products in your city. Write to 1000 Peachtree Street, Atlanta, Georgia.

Dogs, Birds, Fish

DOGS, BIRDS, FISH—Engaged bull rings. 6-8 buildings. 301 Peachtree Street, Atlanta.

Duplicating Devices

DUPPLICATING DEVICES—1000 Peachtree Street, Atlanta, Georgia.

Education and Instruction

EDUCATIONAL INSTITUTIONS—1000 Peachtree Street, Atlanta, Georgia.

Electrical

ELECTRICAL EQUIPMENT—1000 Peachtree Street, Atlanta, Georgia.

ELECTRICAL EQUIPMENT—1000 Peachtree Street, Atlanta, Georgia.

Financing and Investments

FINANCIAL INSTITUTIONS—1000 Peachtree Street, Atlanta, Georgia.

For Boys

FOR BOYS—1000 Peachtree Street, Atlanta, Georgia.

For Men and Women

FOR MEN AND WOMEN—1000 Peachtree Street, Atlanta, Georgia.

FOR MEN AND WOMEN—1000 Peachtree Street, Atlanta, Georgia.

I Will Train You At Home To Fill a Big Pay Radio Job

"I give you all
this apparatus
so you can learn
quickly at home
*the Practical
Way*"

JES
FREE
OF
EXTRA
COST

**You Get
All of This**

All instruments shown here and others sent to all my students free of extra cost under short time special offer. Clip coupon now—find out all about this big unequalled offer while you still have time to take advantage of it. This training is intensely practical—these instruments help you do the practical work. You learn workmanship and get added confidence in your ability.

**World Famous
Training That
"Pays for Itself"**

My Radio course World-Famous as the training that "pays for itself" Makemore Money! When you take up this practical course, Work in millions of American radio sets offers you big chance to make extra time cash while you're learning. I'll show you how—teach you the latest "dope," furnish you with business cards, show you how to get the business and make "easy" millions in less than a year! Increase their income. They report \$1,000, \$1,500, RE AND'S as a result of this course—start two or three weeks after starting.

**\$75 In One Day For
T. M. Wilcox**

"I am in business for myself and RECENTLY MADE \$70 in ONE DAY. I was an applicant of high experience, occupying a splendid position as telephone superintendent when I enrolled with you, believing it would open up greater opportunities—have not been disappointed. Estimate Radio will be worth issue of thousands of dollars to me in next few years."

EMPLOYMENT SERVICE TO ALL GRADUATES

Originators of Radio Home-Study Training

If you're earning a penny less than \$50 a week, clip coupon now. Send for AMAZING FREE BOOK, "Rich Rewards in Radio." Why go along at \$15 or \$35 or \$45 a week, when you could earn \$50 to \$250 in the same six days, as a Radio Expert? Hundreds of N. R. I. trained men are doing it—why can't you?

**Earn up to \$250 a Week—
RADIO EXPERTS IN BIG DEMAND**

Radio needs trained men. Get into this new live-wire profession of quick success. It's the trained man, the Radio Expert, who gets the big jobs of this profession—paying \$75, \$100, \$200 a week and up. Every day N. R. I. trained men are taking good places in the Radio field—men just like you—their only advantage is TRAINING. You can prepare just as they did, by new practical methods. Our tested clear training makes it easy for you. Big Free Book contains all the good.

You Learn Quickly In Spare Time

So sure am I that I can train you successfully for a better future in this new Big-Pay profession, that I guarantee your training with a money-back bond. Lack of experience or education won't hold you back—common schooling all you need to start. You can stay home, hold your job, and learn quickly and pleasantly in your spare time. My practical, helpful methods enable you to start **RIGHT AWAY** toward one of the bigger Radio jobs paying \$50 to \$250 a week. No delay, no losing time from work—no scrapping—
start today to end your training.



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thanks to you. I handle all negotiations, plus do operating. Your course taught me not only the theoretical but also the practical knowledge that makes my work easy for me." Keith Kimball, Station WMAG, Chicago, IL.

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Most amazing book on Radio ever written
—full of facts and pictures—tells all about
the great new Radio field, how we prepare
you and help you start. You can do what others
haven't done. **GET THIS BOOK.** Send coupon
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NATIONAL RADIO INSTITUTE
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Your Satisfaction Guaranteed

We who know the results this practical tested training gets—the increase in earnings it has brought—can't wait to tell you about it all the way with a strict guarantee that you will get back every cent you've invested in this offer—**you yourself are the only judge.** It's your big chance for one of the bigger Radio fortunes—**come now** for my big **FREE BOOK** and proof! No obligation.

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you send me your free book. Rich Rewards in Radio
and all information about your practical, home-study
Radio Course.

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Page 14

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2000-0000



"Can he really play?" a girl whispered.
"Heavens no!" Arthur exclaimed. "He never played a note in his life."

They Laughed When I Sat Down At the Piano But When I Started to Play!—

ARTUR had just played "The Rosey." The room rang with applause. I decided that this would be a dramatic moment for me to make my debut. To the amazement of all my friends, I strode confidently over to the piano and sat down.

"Music is up to his old tricks," somebody chuckled. The crowd laughed. They were all certain that I couldn't play a single note.

"Can he really play?" I heard a girl whisper to Arthur.

"Heavens, no!" Arthur exclaimed. "He never played a note in all his life. But just you watch him. This is going to be good."

I needed to make the most of the situation. With mock dignity I drew out a silk handkerchief and lightly dusted off the piano keys. Then I rose and gave the revolving piano stool a quarter of a turn, just as I had seen an imitator of Paderewski do in a vaudeville sketch.

"What do you think of his execution?" called a voice from the rear.

"We're in favor of it!" came back the answer, and the crowd roared with laughter.

Then I Started to Play

Instantly a tense silence fell on the guests. The laughter died on their lips as if by magic. I played through the first bars of Liszt's immortal Laendler. I heard gasps of amazement. My friends sat breathless—spellbound.

I played on and as I played I forgot the people around me. I forgot the hour, the place, the breathless listeners. The little world I lived in seemed to fade—seemed to grow dim—unreal. Only the music was real. Only the music and the visions it brought me. Visions as beautiful and as changing as the wind blown clouds and drifting moonlight, that long ago inspired the master com-

poser. It seemed as if the master musician himself were speaking to me—speaking through the medium of music—not in words but in chords. Not in sentences, but in exquisite melodies.

A Complete Triumph

As the last notes of the Laendler died away, the room exploded in a sudden roar of applause. I found myself surrounded by excited faces. Only my friends carried on. Men shook my hand. Women congratulated me. I pounded on the back in their enthusiasm. Every body was re-living with delight playing me with "and you could play like that." "Jack! Why didn't you tell us you could play like that?" "Where did you learn?" "How long have you studied?" "Who was your teacher?"

"I have never even seen my teacher," I replied. "And just a short while ago I wouldn't play a note."

"Quit your kidding," laughed Arthur himself an unrepentant pastur. "You've been studying for years. I can tell."

"I have been studying only a short while. I'm not!" I decided to keep it a secret so that I could surprise all my folks.

Then I told them the whole story.

"Have you ever heard of the U. S. School of Music?" I asked.

A few of my friends nodded. "That's a correspondence school, isn't it?" they exclaimed.

"Exactly," I replied. "They have a new simplified method that can teach you to play any instrument by heart in just a few months."

How I Learned to Play Without a Teacher

And then I explained how for years I had learned to play the piano.

"It seems just a short while ago," I continued, "that I saw an ad in the U. S. School of Music mentioning a new method of learning to play which only cost a few cents a day! The ad told how a woman had mastered the piano in her spare time at home and without a teacher! Best of all, the whole thing cost her next to nothing, required no laborious scales, neither theory, etc., etc., to be learned, practicing. It sounded so convincing that I filled out the rough card and sent for the free Demonstration lesson."

The free book arrived promptly and I started on that very night to study the Demonstration Lesson. I was amazed to see how easy it was to play the new way. Then I sent for the course.

"When the course arrived I found it was just as the ad said—so easy as A. B. C. And as the lessons continued they got easier and easier. Before I knew it I was playing all the pieces I had best. Nothing stopped me. I could play ballads or classical numbers, or jazz, all with equal ease. And I never did have any special talent for music."

* * * *

Play Any Instrument

You, too, can now teach yourself to be an accomplished player in right at home—in half the usual time. And make no mistake with this simple new method which has already shown almost half a million people how to play their favorite instruments. Forget that old-fashioned idea that you need special talents. Just get the set of instruments in the piano, decide which one you want to play and the U. S. School will do the rest. And bear in mind no matter which instrument you choose, the cost to each case will be the same—just a few cents a day. No matter whether you are a mere beginner or already a good performer you will be interested in writing about this new and wonderful method.

Send for Our Free Booklet and Demonstration Lesson

Thousands of accomplished students never dreamed they possessed this sort of ability until U. S. School of Music mentioned a new method of learning to play which only cost a few cents a day!

If you are in earnest about wanting to play your favorite instrument—if you really want to gain popularity and increase your popularity—send at once for the free booklet and Demonstration Lesson. No cost, no obligation. Right now we are making a special offer for a limited number of new students. Send and send the enrollment coupon now before it is too late to gain the benefits of this offer. Instruments supplied when needed, cash or credit. U. S. School of Music, 62 Brunswick Bldg., New York City.

U. S. School of Music,
62 Brunswick Bldg., New York City

Please send me your free book, "Music Lessons in Your Own Home," with introduction by Dr. Frank Clark, Demonstration Lesson and particulars of your Special Offer. I am interested in the following course:

Have you above instrument?

Name: (Please write plainly)

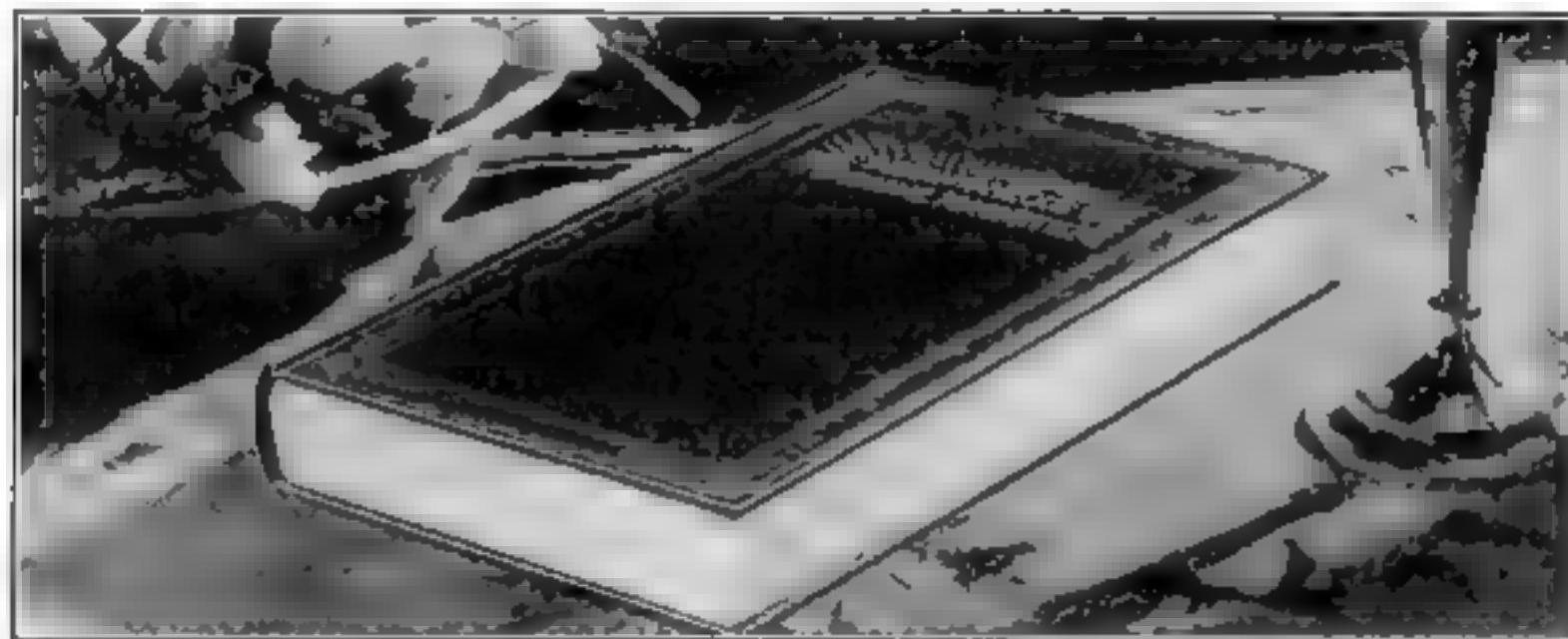
Address:

City: State:

Pick Your Instrument	
Piano	Harmony and Composition
Organ	Sight Singing
Violin	Guitar
Drums and Ukulele	Hawaiian Steel Guitar
Trapeze	Harp
Mandolin	Saxophone
Clarinet	Cornet
Flute	Piccolo
Bassoon	Trombone
Voice and Speech Culture	Automatic Finger Control
Automatic Finger Control	Piano Accordion
Piano Accordion	Banjo/5-String Mandolin/Fiddle

This Singular Book Wields a Strange Power Over Its Readers

Giving them a MAGNETIC PERSONALITY almost instantly!



Will You Read It 5 Days FREE—to Prove It Can Multiply Your Present Income?

A STRANGE book! A book that seems to cast a spell over every person who turns its pages!

A copy of this book was left lying on a hotel table for a few weeks. Nearly 400 people saw the book—read a few pages—and then sent for a copy!

In another case a physician placed a copy on the table in his waiting room. More than 200 of his patients saw the book—read part of it—and then ordered copies for themselves!

Why are men and women so profoundly affected by this book?—so anxious to get a copy? The answer is simple. The book reveals to them for the first time how any man or woman—old or young—can develop a Magnetic Personality *instantly!* It explains how to gain overnight the personal charm that attracts countless friends—the self-confidence that insures quick success in any business or profession.

It tells how to draw people to you at once, irresistibly—how to be popular everywhere, in any society—how to overcome almost at once any timidity or self-consciousness you may have—how to be a magnet of human attraction, popular and well-liked wherever you go!

It not only tells exactly how to accomplish these things—it tells you how to accomplish them without delay—*instantaneously!*

Whence Comes This Uncanny Volume?

Forty years ago, Edmund Shaftesbury, famous student

of the human mind, set out to discover the secret of that rare quality—magnetic Personality. He first applied his discoveries in his own circle of friends. Results were astonishing! His methods seemed to have the power of almost instantly transforming people into entirely new beings!

Quietly, almost secretly, Shaftesbury's fame spread. Great men came to him. His students and friends embraced such names as Gladstone, Queen Victoria, Edwin Booth, Henry Ward Beecher, Cardinal Gibbons, and others of equal fame.

Until recently, Shaftesbury's teachings have been available only to people who could pay \$30 or \$100 each for instruction books. But now, through the efforts of a group of his students, his wonderful teachings have been collected into a single volume, at a price *within the reach of all!*

And furthermore Shaftesbury has consented to reveal hundreds of new discoveries never before put into print.

Strange Effect on Readers

Readers of this book quickly become masters of a singular power to attract others—to influence men and women around them. Not by force—not by loud argument. But rather by some subtle, fascinating power that sways men's minds and emotions. They are able to play on people's feelings just as a skilled violinist plays upon a violin.

Folks are never the same after reading this book. Their manner changes. The tone of their

Book Tells You

How to develop a Magnetic Personality
How to use subtle Oriental secrets
How to gain perfect nerve control
How to read people's feelings by watching the way they move
How to use people's thoughts by watching their eyes
How to develop a magnetic smile
How to make your face appear 10 years younger
How to control others by a glance
How to use Magnetic Healing
How to end shyness and timidity
How to attract the opposite sex
How to get ahead in business
How to make your subconsciously mind work harder
And dozens of other vital topics

voice, the expression in their eyes—yes, even their actual features seem to change—seem to grow more cultured, more refined.

The eyes—windows of the soul—become clear, beautiful, expressive—luminous as a crystal sphere. The voice grows rich, resonant—mellow as a golden bell. Folks listen spell-bound—charmed by the fine modulations—the cultured fluency of the tones.

What Others Say

What precious benefits—so abundant so far-reaching! Is it any wonder that hundreds of men and women say that they are overjoyed with the results they have received. One lady who paid of this volume, "Things I have read there I would never have learned of." Another wrote, "Very wonderful like walking up a staircase to a higher life." Another wrote, "I would not give up what Shaftesbury has taught me for \$100,000!"

In your everyday life—in social life—and especially in business, you will find what these people say to be true. You will find this book of immense value. You will quickly learn to fascinate people you meet. To attract new friends. To gain the speedy promotion and big pay which always come to men and women who have developed but one wonderful of all qualities—a magnetic personality!

Read This Book 5 Days Free

You must see this book for yourself—examine it—let it influence indirectly your own personality. Merely mail coupon below and this remarkable volume, with cover in handsome dark burgundy cloth, gold embossed, will be sent you by return mail for 5 days' free examination. If you aren't satisfied and interested in the 5-day free period, return it and it costs you nothing. Otherwise keep it as your own and remit the Special Wholesale Price of only \$3 in full payment. This volume was originally published to sell at \$5—but in order to reach as many readers as possible—it is now being offered at this special reduced price. This offer may never appear again. So you are urged to act at once, before it is withdrawn. Remember, you do not pay unless you decide to keep the book. You risk nothing—so clip and mail the coupon to Ralston University Press, Dept. 14-B, Meriden, Conn.

RALSTON UNIVERSITY PRESS
Dept. 14-B, Meriden, Conn.

All right—I'll be the judge. You may send me the volume "Instantaneous Personal Magnetism" for 5 days' FREE EXAMINATION in my home. Within the 5 days I will either remit the special low price of only \$3.00, in full payment, or return it without cost or obligation.

Name _____

City _____

State _____

Bits of Mechanism That Save Us Millions

(Continued from page 18)

uncanny mechanisms in the role of Sherlock Holmes. A bank in Chicago, for example, was disturbed recently by a situation that seemed to indicate the presence among the employes of a pilferer of postage stamps. One who will steal stamps sooner or later will begin to take yellow-backed bills, that bank fears.

For many years cancelled checks had been mailed out to the bank's customers at the close of every month under the supervision of an old employee. When he died, his work was turned over to a younger man who was too eager to be thorough with the task to supervise it properly. For three months in succession the postage that was used up by the clerks who did that work exceeded by \$20 the amount that had been used in the old man's time.

A new postage scale was installed in that department. It was an exact scale which left no excuse for a clerk to put eight cents on a four-cent letter. The month after that scale went into service, the postage cost dropped to the old figure. It solved the mystery of the excessive postage, and in addition simplified a troublesome end-of-the-month task.

BEFORE we could have automobiles, someone had to figure out a way to overcome inertia without the use of horses. Horsepower was needed, and the gas engine was the answer. We still measure the power of those engines in terms of horsepower, and the power of a single horse is computed by fixing a load for a standard horse to pull up out of a pit in a given time. Literally one horsepower is the pulling power that hypothetical horse can exert against the contrary pull of gravity.

So, in Detroit, when automobile engineers wish to determine the horsepower of a newly minted gas engine, they harness it to a scale, start it, and then read its horsepower on the dial as easily as my butcher, Mr. Bloom, now reads the price of my daily meat purchase.

OTHER superhuman scales in automobile factories show on a dial the ability of a spring to withstand the shocks of a bumpy, rutted road. The device, essentially, is like one of those contrivances with which youths vain of their muscular ability are permitted to "show off" at Coney Island and country fairs.

A great wooden maul is provided for the strong young man, he whips it about his head and brings it down on a rubber-shod stake. The force of the blow sends an arrow flying upward along a scale. If the arrow strikes the bell at the top, the youth thereafter poses among his friends as a strong man.

In the automobile factories the force of the blow that simulates the shocks of a poor country road is known in advance. When the spring rebounds under this artificial attack, it is a sound spring, for its temper has been subjected to a strain greater than it is likely to encounter in service. The

(Continued on page 240)



Daring Young Men Needed in Aviation

THREE is no field of work in the world today which offers such amazing opportunities to young men of daring and who love adventure, as does Aviation. Although still in its infancy, there is a crying demand in Aviation for young men with courage, nerve and self-reliance. For those who can qualify there will be thousands of highly paid jobs which will lead quickly and surely to advancement and success.

Big Opportunities Await the Trained Man

Look over the fields of work which are open to the young man today. You will find that Aviation is the ONE FIELD that is not overcrowded—the ONE FIELD in which there is plenty of room at the top. Think of it! Only 21 years ago Orville and Wilbur Wright made the world's first airplane flight. Now airplanes fly around the world. Yes, Aviation offers the same wonderful opportunities today that the automobile and motion picture industries did 15 and 20 years ago. Men who got in on the ground floor of those industries made fortunes before others woke up. AVIATION IS NEW! It clamors for pearly young men—and the trained man has the world before him in Aviation.

Easy to Become an Aviation Expert—\$50 to \$100 a Week

You can qualify now quickly for one of these exciting, highly paid jobs through a new sure, easy method of training. The study of Aviation is almost as interesting as the work itself. Every lesson is fascinating and packed full of interest. That's why Aviation is so easy to learn—you don't have to force yourself to study—once you start, you can't get enough of it. Only one hour of spare time a day will give you the basic training in an amazingly short time.

One student, S. P. McNaughton, Chicago, says,

"Your lessons are like a romance, and what is more after one reading, the student gets a thorough understanding. One never tires of reading them."

James Powers, Pa., another student, says: "I am indeed surprised that such a valuable course can be had from such practical men for so little cost."

Personal Instruction by Experienced Men

Men who have had actual experience in Aviation give you personal attention and guide you carefully through your training. They select the lessons, lectures, blueprints and bulletins. They tell you the things that are essential to your success. Every lesson is easy to read and quickly understood.

PREPARE For One of These POSITIONS

- Aeronautical Instructor \$60 to \$150 per week
- Aeronautical Engineer \$150 to \$300 per week
- Aeronautical Contractor Enormous Profits
- Aeroplane Repairman \$45 to \$75 per week
- Aeroplane Mechanician \$60 to \$100 per week
- Aeroplane Inspector \$60 to \$70 per week
- Aeroplane Salesman \$3000 per year and up
- Aeroplane Assembler \$45 to \$65 per week
- Aeroplane Builder \$75 to \$200 per week

Big Book on Aviation FREE



Send coupon below for New Free Book, just out, "Opportunities in the Airplane Industry." It is interesting and instructive and will show you many things about Aviation which you never knew before. Only a limited number offered—get yours before the edition is exhausted.

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Name
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BITS OF MECHANISM THAT SAVE US MILLIONS

(Continued from page 140)

platform—the iron rod—into the earth, but in places unsuited for road making it would drive the rod in deeper and more quickly. Then Mr. Fleming equipped his contrivance with a dial that measured the resistance of the area where road building was contemplated, measured it in the same terms that a grocer measures sugar.

Any housewife who has seen a giant crane swing its mammoth arm into a car loaded with scrap iron and pick up a huge load with a single magnetized finger, must have wondered how men can make steel so haphazardly when she has to measure so carefully in making biscuits.

IF THE housewife would investigate, as I did, she would see that before that giant arm load of scrap metal was released into a great pot to be cooked into steel it was weighed. The cranes of the steel mills are equipped with scales so that the midgets who operate these giant slaves may tell to a pound the size of the load of iron that is tossed into the cauldron. Not only do these scales tell their story to the men who run them, but the size of the loads is registered simultaneously on dial faces in the office of the steel maker, some distance away.

In the great tire factories at Akron the ingredients of a rubber compound are measured as carefully as a doctor's prescription. If, however, the mixing of rubber were done in the same hand labor fashion as the drug store prescription, a lot of us who now ride in automobiles would be walking because of the high cost of tires. In the tire factory, a checking scale automatically allows the passage of oil to the mixing room of metal baskets holding the various ingredients for the rubber mixture that is to be made. If the baskets have too much or too little, that scale inspector reports the fault.

IF IT were not for one of these guardian scales, the people of Minneapolis would, some unhappy day, find the water that flows from their faucets tasting abominably of that flavor which the soldiers of the A. E. F. called "vaccinated." After the chemists of the Minneapolis water supply department have made their bacteria counts, they determine the necessary amount of chlorine. The big chlorine bottles, each containing 150 pounds, are suspended over the channel through which the water flows. One scale measures the flow of water; another scale measures the flow of chlorine. Between these two automatic servants, Minneapolis gets a water supply that is not only safely sanitary but free from the nauseating flavor of the purifying agency.

In every phase of the management of the big enterprises that make it possible for Americans to have more creature comforts than any other people in the world, scales are playing a magic part.

Suddenly deprived of them, our world would be a topsy turvy place in which few of us would be able to determine the value of anything.



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How to enlarge your vocabulary
How to develop self-confidence
How to acquire a winning personality
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How to be the master of any situation

and do not know it. Men in almost every profession and line of business have made this test and then taken their first step toward success in a large way.

Why Powerful Speakers Are Always Leaders

It is the man who can put his ideas into an inspiring speech that makes it easy others to fit in and dominate masses of a thousand who is sought out and asked to fill big, important public positions. He is a leader he stands head and shoulders above the mass. I am going to prove that it can be such a man by simply bringing out your hidden personality which is fighting for recognition but which you keep hemmed in by self-consciousness, lack of confidence in yourself, timidity and bashfulness.

It Is Amazingly Easy to Quickly Become a Powerful Speaker

You do not need a college education nor any previous voice training to become a powerful speaker.

I will show you the secret that causes one man to rise from an obscure position to the head of a great corporation, another to rise the rank and file of political workers to national chairman; still another to rise from obscurity to the national leadership of great labor unions. It is bold and startling truth to change suddenly into a popular and quickly acclaimed a teacher and lecturer or writer. These names have accomplished just such amazing things due to this simple, easy yet effective training.

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I do not care what line of business you are in; how beautiful, timid and self-conscious you now are; I will guarantee to make you a powerful, commanding and easy speaker within a few weeks if you will give me 15 minutes a day in the privacy of your own home. I know what I have done for thousands of others and what remarkable results have been secured often in a month or less. Therefore, if I can not make you a powerful speaker I guarantee to return every penny you have paid me and you owe nothing.

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Thomas Jefferson, Scientist

(Continued from page 19)

from the beginning, under the influence of Jefferson, have been based upon the idea of giving the inventor the most complete protection and opportunity for profit. This was in accord with Jefferson's political creed, which placed the rights of the individual above those of the State.

Beyond doubt the greatest stimulus which Jefferson experienced in his pursuit of scientific knowledge came from Benjamin Franklin. The two men served together in the Continental Congress and their friendship lasted until Franklin's death. At the close of the Revolution Jefferson was sent to France, first as an assistant to Franklin in negotiating treaties, then as Franklin's successor as Minister to France. Paris, even in those troubled times, was the world's center of science, and here Jefferson formed contacts which lasted the rest of his life.

AS A farmer his first interest was in matters botanical and agricultural. In the great variety of trees, grains and fruits grown in Europe he sought new species which might be successfully introduced on this side of the Atlantic. I plant rice was one of these, and for years he attempted to establish its culture in the South. He sent over many cuttings of olive trees, in the hope that they might flourish in the new world. After his return from France, for twenty-three years he received annually a box of seeds from Paris.

An interesting phase of his stay in Paris was his attention to the manufacture of artificial pearls, then just beginning to be established by the method whereby fine pearl imitations are still made. Thin glass spheres are covered on the inside with a solution of fish scales known as "essence de l'Orient." The center is then filled with wax and the result is a gem which retains the luster of the true pearl for many years. It occurred to Jefferson that some species of American fish might yield the "essence," and he had his friend, Francis Hopkinson, send over several bottles of fish scales. But nothing came of this because, as Jefferson wrote back, pearls were getting out of fashion, "polite people are not wearing them at all and the poor are not able to buy them."

BACK in America he began the correspondence with the great French naturalist Buffon, whose statement about North American animals in his new book Jefferson successfully challenged. He wrote the first recorded description of the pecan nut, a native of America. In some of his letters he discussed the relationship of forests to rainfall in a manner quite in accord with modern scientific knowledge. He engaged in speculative theories as to the American Indians, whom he was one of the first to regard as of Asiatic origin.

On his farm he made many implements and instruments, some of original design, others patterned after objects he had seen abroad. Besides the plow, swivel chair, buggy top and hemp beater already mentioned, he invented a barometer, a thermometer and a wind gage. He

worked out scale drawings for the construction of a carriage. Hearing that a man named Hawkins, of Frankford, Pennsylvania, had invented a machine called a "polygraph" for writing several copies at once by means of multiple pens, he suggested certain improvements in it, had one made to his own order to use two pens, and thereafter wrote all of his letters with this machine, retaining an exact autograph copy in ink of all of his correspondence. He worked out the markings for a sundial calculated for the latitude of Monticello, his Virginia home.

PROBABLY the most important contribution which Jefferson brought back from France was a complete working knowledge of the Classical Renaissance style of architecture, which he considered to be perfectly adapted to America. His first application of these new architectural principles was in the building of his own mansion, Monticello, which is still regarded as one of the finest specimens of domestic architecture in America. He drew the plans himself and superintended every detail of the construction, even to the building of the kilns for baking the brick of which the house is made. The principal internal innovation over other mansions of the time was the subordination of the staircase from a place of decorative importance into a mere utility.

After building Monticello, Jefferson drew the plans for the buildings of the University of Virginia at Charlottesville. The principal ones of these structures, designed by him, still form the central feature of what is probably the most beautiful group of buildings in America.

AMONG his inventions, the improved moldboard for plows ranks in first importance. This was distinctly a product of American conditions. The older forms of plows were suitable for turning the soil of old clearings; the cultivation of the virgin soil of America required a plow which would turn over the heavy sod of the prairie. Jefferson's original model was sent to Paris, where it is still to be seen at the Institut National Agronomique.

Next to the Revolution itself, the most important episode in the history of the United States was undoubtedly the purchase from France of the great territory known as Louisiana, stretching from the Gulf to Canada and from the Mississippi to the summit of the Rockies. Jefferson, as President, was enthusiastically interested in discovering what the new territory held in natural resources. It was under his personal direction that the epoch-making journey of Lewis and Clark, from St. Louis to Oregon, was made. Jefferson had chosen Lewis to head the expedition because of his ability as a naturalist.

Jefferson's interest in science never abated, although he lived to the ripe age of eighty-three. At seventy-five we find him becoming a subscriber to the first scientific publication on this side of the ocean, the *American Journal of Science*, with a letter of appreciation to its editor,

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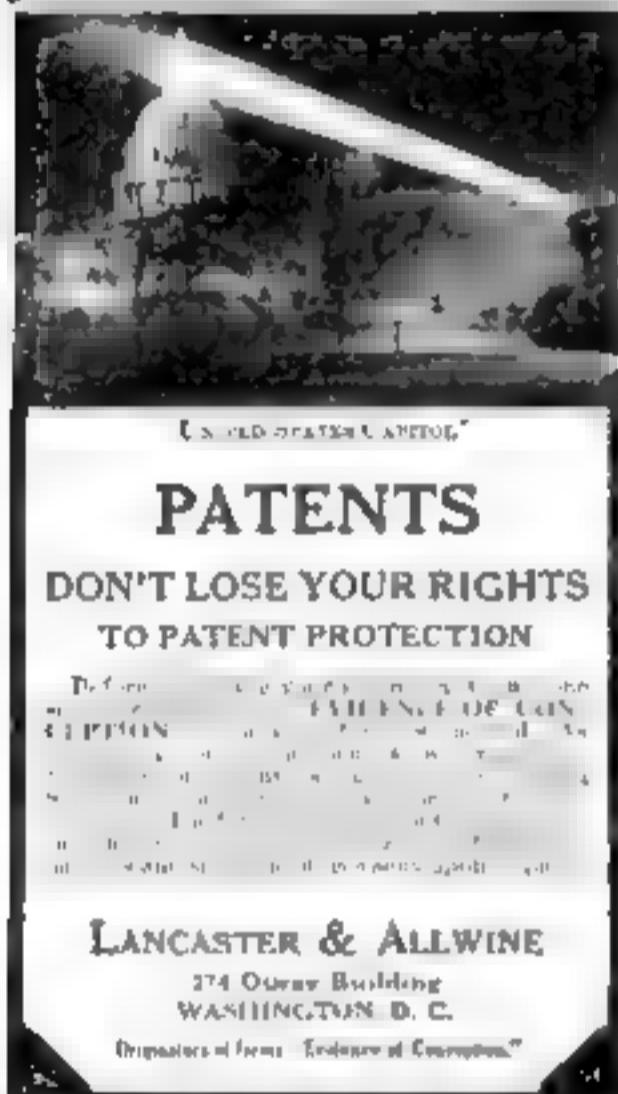
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Conquest of the Deep

(Continued from page 81)

death twenty years before. Hoar was sucked into the mouth of an outlet pipe. For four days rescuers frantically tried to pull him from the grip of the rushing waters. He died when a rope fastened around him, pulled by a team of horses, cut through his diving suit and allowed the water to enter.

A THING dreaded by divers as much as anything is the possibility of falling into a hole. Suddenly increased pressure resulting from a fall has the effect of forcing air from the rubber diving suit into the helmet. When that happens, the extra pressure may drive the diver into his helmet with such force as to cause serious injury or death. This type of accident is called a "squeeze." Improved means of controlling the air supply has somewhat reduced this danger.

While medical science has listed various causes of underwater mishaps, divers have some strange adventures that defy classification. Charles P. Everett once missed death by inches while working on the wreck of a sunken ferryboat in New York harbor. At slack water there was a wide space between the outer and inner hulls of the ship, and into this space Everett walked. While he was there the tide turned, and the current closed the gap. With such tools as he carried, Everett managed to escape from the trap by tearing a hole in the hull large enough to allow his body to pass.

Emergencies like this, requiring unexpected exertion quickly sap the strength of the diver, especially at great depths. A Y. Catto, gunner in the British Navy, attested this after an experience in which his lines became entangled with an anchor hawser 180 feet down. For normal underwater work his air supply was sufficient, but not for the struggle required to free himself. After twenty minutes he was so weakened by asphyxiating carbon dioxide that he realized he might become unconscious unless he stopped to rest. But he dared not rest, for he already had greatly exceeded the time considered safe for submersion. In this dilemma he risked unconsciousness, made one supreme effort—and found himself free.

THROUGH the glass windows of their helmets, divers look upon many strange creatures of the deep; yet these are not the enemies that they fear. Many stories have been told of battles between divers and man-eating sharks. Actually, though, divers say, sharks can be frightened away easily by releasing air bubbles from the diving suit. The octopus is more dangerous. Some years ago T. Yamaguchi, a Japanese diver working near the coast of Southern California, was attacked by a devil fish weighing nearly 300 pounds. He stepped right into the creature's tentacles, and in a second the great arms were entwined about him. Exhausted by his struggles, he gave the emergency signal and was hauled to the surface, the octopus still clinging to him. The tentacles had to be cut away before the man could be released from his suit.

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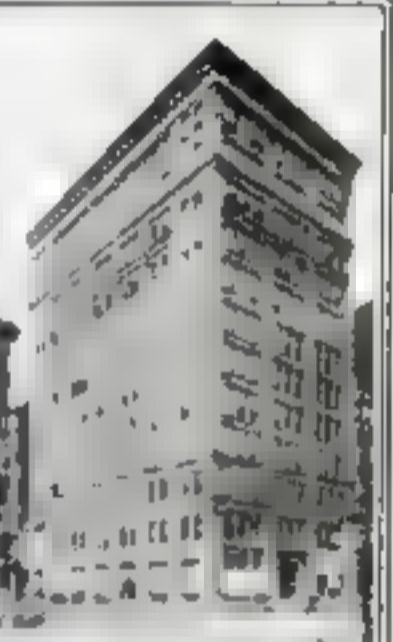
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Nature's Building Bricks

(Continued from page 146)

ever realize that in this yard there is between three and three and a half miles of thread? This thread did not grow on a plant or an animal's back in this fashion. It had to go through literally dozens of preparatory operations before it was ready for the shop keeper to hand it to you over his counter. All the skill that science can muster has been employed in separating the little vegetable bricks from the natural mortar, so that we could produce cellulose and build up new wonders.

A vista of really wonderful possibilities is opened up by the development of rayon, the new silk. This wonderful fiber—the only one completely controlled by man—is only artificial silk, that is, silk produced without the assistance of the worm. It is built up out of purely vegetable fiber.

Most extraordinary is the list of things we are making from rayon. The modern chemist can take the old kitchen table, the square piano, or the discarded household dress, and turn it into a pair of beautiful, lustrous stockings. He can do much more.

"THE genie of Aladdin's lamp," says Edward T. Pickard, textile expert of the Department of Commerce, "can take the kitchen table and make out of it not only a pair of stockings, but the very best kind of paint for your automobile, motion picture and camera films, insulation, ivory and amber, various forms of celluloid, gunotton, transparent wrappings for candy boxes, unbreakable glass and many other astonishing things."

"What effect has this development of rayon had on the textile industry in general?" I asked Mr. Pickard.

"Revolutionized it. In house-clothing, underwear of every description, it has come to stay. I estimate that we will produce 65,000,000 pounds of rayon during the present year. Last year the production was 55,000,000 pounds. Probably 80,000,000 pounds will represent the world's total in 1926, as against 38,000,000 pounds in 1925."

"TEN years ago, the American people used only a couple of million pounds of rayon. Last year they consumed 60,000,000 pounds. We are now using about the same quantity of rayon as of natural silk."

Through the "mother stuff," cellulose, paper has a good many relatives. Add the smallest proportion of water—one molecule—to cellulose, and the chemist can present to you glucose or grape sugar. Fermented and distilled, this becomes alcohol. All cotton, linen, and other vegetable fibers, speaking chemically, are cellulose. Add camphor to "nitrated" cellulose, and we have the material of which are fabricated moving picture films and many varieties of toilet articles. Dissolve it in ether and alcohol, and this "nitrated" cotton becomes collodion—which is nothing more than a liquid court plaster. Gunotton, smokeless powder and dynamite are "nitrated" cellulose products. And so on, to an almost indefinite length, we might extend the list, built of nature's bricks from vegetable fiber. A romance built on bricks—is it not?

PATENTS

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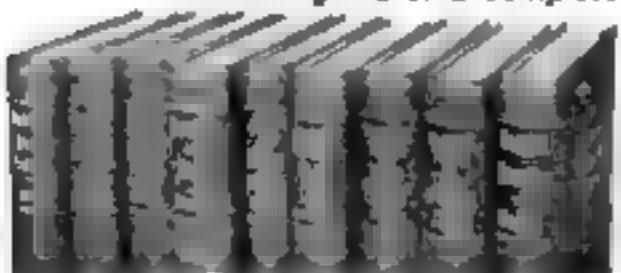
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Could a Gale Wreck Your House?

(Continued from page 150)

hardware, with top and bottom fastenings, should go with the shutters.

Sash with a number of small panes is usually stronger than the one pane kind, and if any of the small panes let go it is easier and less expensive to replace them. The large size may be unobtainable in an emergency. We may consider as "large"—which is quite a relative term—any pane of glass that is at least two feet in each dimension. The fashionable compromise of small panes in an upper sash and a single one below is at least half right from the safety standpoint. If a large pane must be used, it should be plate glass or double thick window glass.

PLATE glass, which is universally used for shop fronts and in public buildings, has the double merit of optical clearness and of strength. It admits the maximum light and gives an undistorted view of objects seen through it. Since it is commonly used in very great sizes and is always on the firing line, so to speak, the disaster reports emphasizing plate glass casualties are misleading. The least standard thickness of plate glass is one eighth inch.

Ordinary window glass in single strength is about one tenth inch in thickness. Double strength panes range in thickness from about one eighth to one ninth inch, and there are still heavier grades up to a maximum slightly exceeding one fifth inch. A home builder would do well to verify sizes. Just a few thin panes that fall below the general standard may cause a lot of trouble.

WIRE glass will stand almost anything, whether shock or pressure, and might be strategically placed at exposed points. Such glass will also retard intrusion of fire from near-by buildings.

Earthquake protection is found in a house of reinforced concrete or of stanchly built wood frame with ample foundations, interior finish of fiber board rather than plaster, roofing that is light and flexible so there are no heavy units to litter the lawn or crash into the dwelling, and especially a chimney that will resist the lurch and wobble of the earth.

From the foundation up, the chimney should be built of not less than eight inches of concrete around flue lining, reinforced with screening wire mesh and also with long vertical steel rods spaced about a foot apart.

In hurricane and cyclone regions, only that part of the chimney that projects above the roof needs strengthening as described for the earthquake zone. An old brick chimney may be fortified against wind by surrounding it with metal reinforcement and adding a coat of stucco.

Mr. McMillon's services are available to our readers to assist them in solving their building problems. Letters will be answered free of charge.

Address John R. McMillon, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.

New Way to Make Money at Home

Would you like to make money at home and have fun doing it? Then read, below, the offer of Mr. Petrie.



General Agents for
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HERE is a simple and most fascinating way to earn money in your spare time and right at home. It is wonderful that companies say it seems too good to be true, but business already know it is true, and you are joining every day. Just think of being in business for yourself, using just a portion of one man's spending as your little shop of your own. What great fun! And how rich are the rewards!

No Special Ability Needed

Don't tell your wife or husband about this. It is a secret. You can make a thousand dollars a month in your spare time and right at home. It is the easiest money you can make. You don't need any special training, just a good will toward Fire-side Industries. You can sell products you can spend 10 hours a day or eight hours a day. The profits are handsome indeed. A pair of candlesticks can be polished in an hour and elegantly make a profit of \$2 for you. Think of it! No previous experience whatever is necessary. The work is made so easy that anyone can follow the simple instructions. A complete outfit of materials is furnished to every member.

Success
Guaranteed

Whether you wish merely to give expression to your artistic taste or wish to turn a profitable profession, Fire-side Industries is the simplest way to do it. Every day we see like this: "I have a hundred thousand dollars in my bank account. I have a fine home and wife and children. I have all the things I want. I have nothing else." Another says, "I could have sold it for twice what I had. Many more take a heavy toll health-wise from the lack of interest that members of Fire-side Industries are so enthusiastic about the work."

FREE! Beautiful New Book on Decorative Arts

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Decorative Art and Earthenware
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Fire-side Industries,
Dept. B1-B,
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Coupons: Without obligation on my part, please send me, I will be glad to receive your work of Fire-side Industries members; also particulars of membership and the special co-operative privileges and services. I enclose two-cent stamp.

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"I'm going to raise his salary and give him that new job we were talking about. I wish we had more men like him."

How do you stand when your employer checks up his men for promotion? Does he class you by as just a routine worker or does he think of you as a man who is ambitious to get ahead? Won't you be far more likely to get the promotion if he knows you are studying at home and are really preparing yourself to handle bigger work?

Think it over. Then act. It takes only a moment to mark and mail the coupon and find what the International Correspondence Schools can do for you, yet that one simple little step may be the means of changing your whole life. "Do it now."

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PAGE - DAVIS SCHOOL OF ADVERTISING,
Dept. 1243 24th Michigan Ave., Chicago, Ill. A.

Answers to the Sam Loyd Tests on Page 43

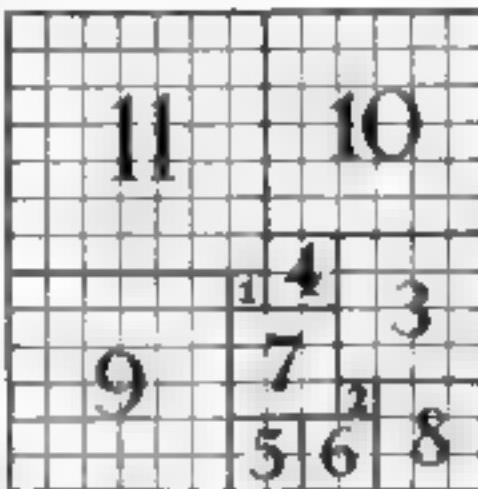
Transposing the Checkers

Here is the sequence of moves necessary to transpose the black and white checkers in the minimum of 40 moves and jumps:

- | | |
|---------------|---------------|
| 1 move east | 23 jump south |
| 2 jump west | 24 move south |
| 3 move west | 25 jump south |
| 4 jump east | 26 jump east |
| 5 move north | 27 move east |
| 6 jump west | 28 jump south |
| 7 move south | 29 move east |
| 8 jump north | 30 jump south |
| 9 move east | 31 jump south |
| 10 move west | 32 move east |
| 11 move west | 33 jump south |
| 12 move south | 34 jump south |
| 13 move east | 35 move east |
| 14 jump west | 36 jump south |
| 15 move north | 37 move east |
| 16 jump east | 38 jump east |
| 17 move north | 39 move west |
| 18 move south | 40 move east |
| 19 move east | 41 move west |
| 20 move south | 42 move east |
| 21 jump south | 43 move west |
| 22 move west | 44 move south |
| 23 jump north | 45 move south |

If you arrived at this solution in one hour, go to the head of the class!

Building the Patchwork Quilt



Here is how the 13-by-13 quilt is divided into its original eleven parts. If you did it in twenty minutes, you earned a high rating.

The Missing "K's"

The completed sentence reads, "Kitty knitted khaki kilts." You have sharp eyes if you solved this in three minutes.

The Mathematical Fisherman

That tuna's head was $2\frac{1}{2}$ feet long, body 41 feet, tail 9 feet, making the whole fish 10 feet long. Ten minutes should give you a good rating.

Target Shooting

The three target scores were composed as follows: First - 50, 10, 5, 9 & 1. Second - 45, 20, 20, 5, 9 and 1. Third - 45, 20, 10, 10, 5 and 1. Figuring this out in twelve minutes gives you a high record as a mental sharpshooter.

"Was He a Good Bargainer?"

The man who dug my cellar worked 30 and $\frac{1}{2}$ days and "had off" 20 and $\frac{1}{2}$ days. This should have taken you only five minutes to solve if you're quick at figures.

The Word Square

Here is the solution:

N	I	C	H	E
I	D	L	E	R
C	L	A	R	A
H	F	R	D	S
E	R	A	S	E

Nine minutes to construct this gives you a good rating.

\$25.00 DRAWING \$2.98 COURSE for

Have I not often wished that you could draw cartoons illustrate some item, a high priced picture, etc.? You can do all of these things using of America's most famous cartoonists and their names have developed a great stamp system for guitars in all branches of commerce, art, etc. Then a stamp has really taught the entire course of drawing 31 hours that drawing can be learned for just writing much simpler than learning shorthand, bookkeeping or accounting. We are now placing this original system for learning Drawing Art and Painting consisting of 36 lessons in 31 over 300 illustrations, which teach of every one. I will send a free sample each week to the course. WE ALSO OFFER A DRAWING COURSE. And you will learn to draw and draw well before you have half finished the course. If we fail to make the claim stand, we will refund every cent paid up. By sending us a large number of drawings, we will evaluate, expense, postage, etc., we are enabled to make a profit of \$2.00, the standard price over here. In a week's time, you will have a better drawing ability than you ever had before. It is a big asset, no matter what field you are in.



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Fyr-Fyters make amazing demonstration in a minute and sell fast. Every property owner instantly recognizes the need for **Fyr-Fyters**. One customer after boy go to see at one time.

One city block is capable of sales running into thousands of dollars. You make a \$1000 sale. Driven truck a \$1000 under. Homes or farms, alone, can pay you \$10,000 a year.

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What Does Your Face Tell Your Boss?

(Continued from page 156)

son, is almost always depicted as having a sharp, pointed nose.

A high bridge is supposed to be the sign of the dominant type, the fighter, the executive. New York's governor, Al Smith, is so equipped. So is Charles M. Schwab, of steel fame.

Single out one of your acquaintances who is noted for his caution and watch him when he is trying to make some decision. You will notice that the muscles of his nose contract in a downward movement. Now imagine that movement multiplied thousands of times and you can see that the result will be to bring the fleshy part of the nose up down and in. That is the basic reason for the physiognomist's belief that the turned-under nose tip signifies caution. President Coolidge's nose possesses that characteristic in conjunction with the high bridge of the executive.

AN IDEAL nose from the viewpoint of physiognomy is straight, of good size, well rounded. That, we are told, will be found on the man of energy both mentally and physically.

In the case of the small nose, tilted at the tip, the decision is somewhat colorless. This will be found, we are informed, on a person who has no outstanding abilities and no glaring faults. The small, straight nose may be an attribute of beauty, but no physiognomist is likely to wax enthusiastic about it.

When the nose begins to sit right down on the face and spread all over it, then trouble is in sight. When the rest of the face tells the same story, the squat nose is read as the mark of the criminal. Sergeant DeVoe approves that interpretation.

"You have heard," he told me, "of bush workers—men who prowl around on the streets early in the morning in search of prey. Perhaps in a railway station such a thief finds a man waiting for a train. The fellow, drunk or dead tired, has fallen asleep on a bench. Nudging him and finding him unconscious, the bush worker goes through his pockets.

"Thus meanest coward of the underworld has distinctive facial characteristics. He has a long, narrow face, not intelligent enough in appearance to be called crafty. His eyes are little, but long and set far apart. His lips have a loose quirk, and his nose is broader than you would expect on a lean face. But it's the expression of the whole face that gives him away."

NEXT in line for consideration is the mouth. In the ideal formation, as the physiognomists see it, the lips are set in a firm, straight line, with some of the red showing.

Physiognomists regard the mouth as the index of the physical side of man. The sensual person will have drooping, bucky lips, displaying too much of the inner red, which is far more sensitive to contact than the white outer skin.

Conversely, when a person has thin lips drawn too

(Continued on page 157)

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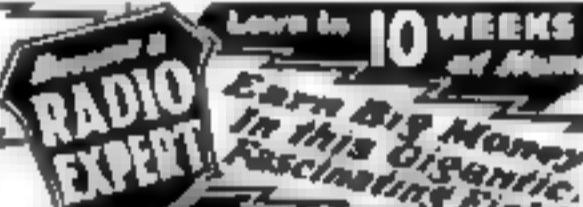
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Advice for POPULAR SCIENCE MONTHLY readers regarding safe and profitable investments.

See Page 6.

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Name _____
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City _____ State _____ Zip _____

What Does Your Face Tell Your Boss?

(Continued from page 136)

tightly together, he is read as one who has little sentiment, perhaps even crafty and cold-hearted. Parched, cracked and uneven lips are danger signals, we are told, of temper.

The general contour of your face has a great bearing on final deductions. When correctly formed, physiognomically speaking, it is as wide at the base of the jawbone as above, measuring from the outside of one eye to the other. The jawbone itself should then curve in convex fashion to the point of the chin. This conformation is modified somewhat in the case of a woman, the width being less at the bottom than that at the top.

THE more the face takes on the shape of an inverted triangle, the more physical weakness is said to be present. A man of the extreme mental type will have a head very high and wide, tapering to a point at the chin, and the jawbone, instead of being convex, will follow a concave course. The heavy jaw, wider at the base, is equally not to be desired, according to the physiognomists.

Much can be done by men to disguise their weak points with beards, mustaches, and long wavy hair, the physiognomists tell us. There is a special division of the Rogues' Gallery portraits given over to men who specialize in robbery from women, and the surprising number of mustaches cultivated by this peculiar band of criminals is significant.

There are three general types of profiles—concave, convex and plane—and various combinations of these. The concave, of course, has the high upper forehead, a somewhat dish-shaped face, and a protruding chin. That man, we are told, will be a slow, deep thinker, exceedingly determined when he reaches his decision. The convex-faced man, on the other hand, will be a quick thinker, but somewhat lacking in decision. The man with the plane-shaped profile, that is, straight up and down, says physiognomy, is blessed with a more even distribution of the best qualities of the other two types.

THAT facial characteristics reveal what diseases we may die of, what maladies we are most likely to get and those we shall probably escape, is a newer and equally fascinating branch of physiognomy. Dr. George Draper of Columbia University, who has made a scientific study of this phase, gives his findings in his new book, "Human Constitution."

Pernicious anemia and gall-bladder diseases, we learn, appear in persons having long ears; short ears indicate rather a tendency to ulcer tuberculosis, and kidney troubles. Narrow eye slits are held to go with tuberculosis; wide open eyes, gastric ulcer. Eyes set close together are thought to indicate leanings toward ulcer and tuberculosis, while pernicious anemia and kidney patients have eyes wide apart. A short, broad face points to pernicious anemia and gall-bladder troubles. Short noses also are held to be a mark of pernicious anemia; long noses, on the other hand, of gall-bladder and asthma.



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FIT YOURSELF FOR A BIG FUTURE This course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and meets all requirements of a High School training. From the first lesson to the last you are carefully examined and coached.

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Send the full information on the subject checked, and how you will help me win success.

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Structural Engineer
Business Manager
Court Public Accountant
Accountant and Auditor
Bookkeeper
Drafterman and Designer
Electrical Engineer
Electric Light & Power
General Education
Vocational Guidance

- Business Law
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Machine Shop Practice
Mechanical Engineer
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Station Engineer
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Military Engineer
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Address _____

Age _____

Date _____

Year _____

Month _____

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Year _____



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Here Are Correct Answers to Questions on Page 56

1. The vanishing grizzly bear once common through much of the mountainous part of the western United States, is still found in Wyoming and Montana, and some are reported in the Sierra Nevada in California.

2. Texas, with 16,180 miles of railway.

3. Aside from the many interesting scientific observations that might be possible in the polar regions, the chief practical objects are the obtaining of facts about the polar weather and the possible location of land that some day might serve as a base for travelers by air. Because of the spherical shape of the earth, the distance from eastern Asia to Europe or from western North America to Europe is much less by way of the North Pole than along the usual sea routes. Many scientists believe that air transportation over the Arctic regions will be a fact before many years.

4. Most scientists believe that the ancestors of both Aztecs and Mayas came from Asia, perhaps across Bering Strait, but possibly across the Pacific in canoes.

5. The Bermuda Islands, a British possession, lying well out in the Atlantic, east of the southern coast of the United States, contain 303 islands, most of which, however, are scarcely more than tiny dots of land in the ocean. The entire group of the Bermudas has been constructed, in fact, by coral animals who built up reefs from the shallow bottom of the sea to the surface.

6. Quinine is extracted from the bark of the cinchona tree. This drug was known to the ancient inhabitants of South America, but was first studied by the whites in Colombia in 1735.

7. The collection of upright stones, or "monoliths," at Stonehenge, about seventy-five miles southwest of London. These great stones are set up in circles as though they might have been pillars for some ancient temple, though their original use and the nature of the people who erected them are alike unknown.

8. Liberia, in the southern part of West Africa, founded originally by freed slaves who were returned to their native continent and assisted in many ways by the United States and other countries.

9. This famous image is, in reality, the figure of a crouching lion with a human face. Between the outstretched paws there once existed a small shrine or temple. Historians have concluded, therefore, that the Sphinx was erected for religious purposes, doubtless as a symbol of some half-human being whom the ancient Egyptians regarded as divine.

10. The area that has the greatest rainfall is the northeastern part of India, in the neighborhood of Calcutta. The annual rainfall in this region is more than 600 inches a year.

11. On the slopes of the famous volcano of Mauna Loa, the largest active volcano in Hawaii.

12. This is the result of the activity of the coral polyp, a tiny living creature that extracts lime from the sea and deposits the lime in solid form. This is how coral and coral limestone are produced. Many of the South Sea islands are volcanoes, active or extinct. They are sharp, conical peaks. On the sides of these peaks, just under the water line, the coral polyps build their limestone deposits, which in time grow into reefs.



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This One



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A Big Money-Making Business

A business to enthuse over—the "Ideal" Lawn Mower Sharpener

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FRED C. MILBERT OF ROSELLE, ILL., WRITES: "The Ideal Lawn Mower Sharpener put me in business, starting in the basement of my home and forcing me now for the third time to move into bigger quarters. Today the dream of my life—a shop of my own—is realized. With a machine like yours and a little hustle any man can have a business of his own and be independent."

W. F. Kamm, Buffalo writes: "I sharpened 994 lawn mowers last season, and the receipts were nearly \$1000, of which \$600 was for a side line."

Fred Milbert, Roselle, Ill., writes: "Last June I sharpened 500 lawn mowers for which I received \$100."

Sam Brodbeck, Middlebury, Ohio, writes:

"I made \$100.00 in 30 days with my 'Ideal'. Have made no less than \$100.00 in one day."

E. W. McCormick, Saginaw, Michigan, writes:

"I have ground over 5,000 lawnmowers during the past five years besides working at my trade."

You Start Now

No town too small. D. B. Newcomer of Vinton, Ia., writes: "People come from miles around and from other towns to have their mowers ground." Lawn mowers are dull—owners don't know where to get them sharpened. Mowing the lawn dreaded because of dull or improperly sharpened mower. Lawn mowing beautiful, invigorating and pleasant when mower is "ideally" sharpened. You do the work scientifically—you see in big demand.

Lawn Mowers Sharpened to Razor Edge

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Official tests show that most car owners waste 20 to 30% of their gasoline through improper vaporizing. This simple little device has increased vaporization by a new engineering principle, according to car owners. They also say it picks up power more quickly, ends spark plug and carbon troubles and works in all weathers and roads.

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\$75 to \$150 in a week can be made as distributor for this amazing device, in full or spare time. Other men have earned big quick profits with it. Over a million car owners have bought it. Full page newspaper ads are being used all over America. We give you exact plan to follow that has helped others earn \$75 to \$150 in a week.

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Q. Is there much difference in the value of B-Eliminators?

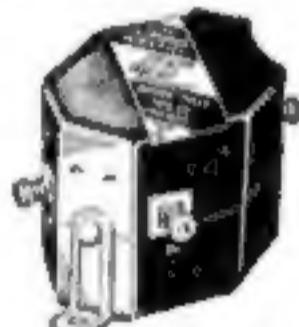
A. Just as much as there is in Radio Sets, Real Estate or Jewelry.

Q. How much should I pay for a B-Power Unit?

A. \$49.50. We consider cheap Eliminators the poorest investment in radio.

Q. Why do you think yours is better?

A. Because we have an exceptional record for producing only high quality. Everything we have ever put out, either in parts, circuits or receivers has been a continued success.



Q. What is the latest in Audio Amplification?

A. In our opinion it is the fact that those best informed are coming back to the belief we have always held, namely, that *good audio transformers* produce the best results and at the least expense of any method known today.

Q. Do you build impedances and such things?

A. We do not, because we believe transformers are better.

Q. Where can I read more on this subject?

A. In *Better Tuning*, a booklet we publish to tell our readers many things they don't find elsewhere.

QUESTION: What is this?

ANSWER. It is a B-Power Unit, a necessity for best radio reception with up-to-date tubes and speakers.

Q. What does it do?

A. It supplies plate—or B-current from the light socket for your receiver at voltages that are really high enough to operate tubes correctly.

Q. Where are the knobs?

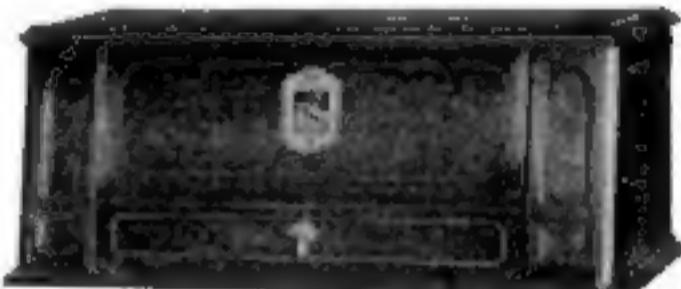
A. There are no knobs necessary with our method,—and consequently no guess-work. You set this unit for the number and kind of tubes in use and there is no more to be done.

Q. Does Better Tuning discuss B-Eliminators?

A. It does—frankly.

Q. Do you build Receivers?

A. We build Counterphase Receivers.



HERE IS THE "EIGHT"—CLOSED

Q. Where are the dials?

A. There are none. Stations are read directly in wave lengths.

Q. But how do you log them?

A. There is no need for logging. Each set is individually logged before shipment and guaranteed correct. This method is patented by us.

Q. How do you tune?

A. Open the door, and turn the knob which tunes five stages at once.



HERE IS THE "EIGHT"—OPEN

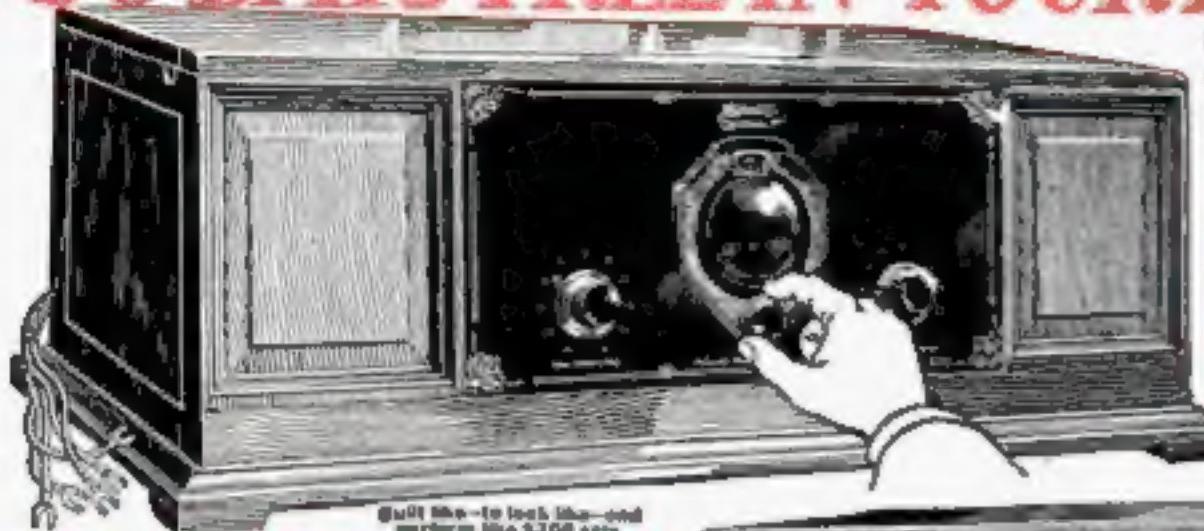
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Thousands of the best radio users have found the new Miraco sets to be the most reliable and up-to-the-minute. Importers such as you must accept to find out our much higher priced sets. Miraco is the best. Best of better-type, beautiful construction—more powerful transmission than ever before.

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Reports from users everywhere leave little for us to say. These are only two of the many in our files and others are positive data, rapid response to plenty of additional proof and testimony of many kinds.

Miraco Separates Stations That More Expensive Sets Can't

Lagged stations from coast to coast, the second evening we had Miraco and got some difficult stations because of so many broadcasting stations coming in under the same number. We can separate them where some of the best receiving sets in the neighborhood cannot. We are well pleased with the set and heartily recommend it. W. J. Peterson, Beloit, Colorado.

N. Y. Heard Europe

I received six foreign stations during last week; 250, OEH, OAX, Lima, Peru, Hamburg, Germany; PTT, Paris, France; SCR, Brussels, Belgium. The Miraco is a fine set! Local and distant stations come in so loud that you have to shut it down. Had Porto Rico on the local speaker last week so you could hear it through the whole house. One ENTHUS, FULTON, New York.

Beats \$200 to \$300 Sets in Demonstration

Miraco is the best performer in this town. I have demonstrated against \$200 and \$300 set, and beat them for distance and quietness.

ORIN W. FAWCETT, Saybrook, Illinois.

Experts Say It Can't Be Beat

I am very well pleased with my Miraco. First in, it was such a surprise that I haven't gotten over it yet. I have operated sets all over the world for the last seven years. I think that I ought to have some idea of what a broadcast receiver should be. I am sure that you have a set that can't be beat. I lagged fifty-six stations first night. A. W. BRYANT, Terre Haute, Ind.

Out Performs Costlier Sets

Like the Miraco very much. The first night I received KFI (Los Angeles), WPG, WHN, CFCF. This is covering from coast to coast, received 47 stations that night, and the next night I received 27 stations. That is more than a lot of sets are doing that cost from 50 to 100 per cent more than mine. It is all you claimed it is and a little more. C. A. MOORE, Van Dyke, Mich.

Alaska Hears Chicago

I am living up here in Alaska one thousand miles from Seattle and it takes a good receiver to pick up any radio in this district, especially near Juneau, our capital city, which seems to be bothered with electrical currents and static, but the Miraco picked up stations as far as Chicago. I've heard Omaha several times. LEONARD F. PARKER, Gustavus, Alaska.

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Miraco is working fine. Have compared it with the former expensive set and find it superior in performance. The most pleasing feature of this machine is the counter-balancer. I haven't seen another set with this remarkable feature, and it makes an impression on those who hear and see. WILLIAM KRISTENSEN, Mapleton, Iowa.



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Compare with Any 6 to 8 Tube Sets—

Unless 30 Days' Trial proves your Miraco the most selective, the clearest toned and most powerful distance-getter among sets using up to 8 tubes—**don't buy it!** Enjoy a powerful big Miraco in your home—at **our risk**—and be thoroughly convinced. **True verdict now—absolutely no strings to our offer.** Satisfaction unconditionally guaranteed.

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Miracos are specially adapted and unsurpassed for economical operation with A- and B-light socket power supply units—or with batteries. Power tubes and more than 90 volts of "B" Current may be used, although the power built right into a Miraco makes unnecessary the use of other than regular tubes and 90 volts.

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morally and financially the
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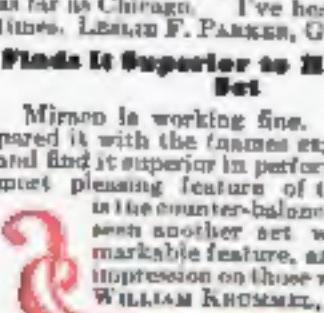
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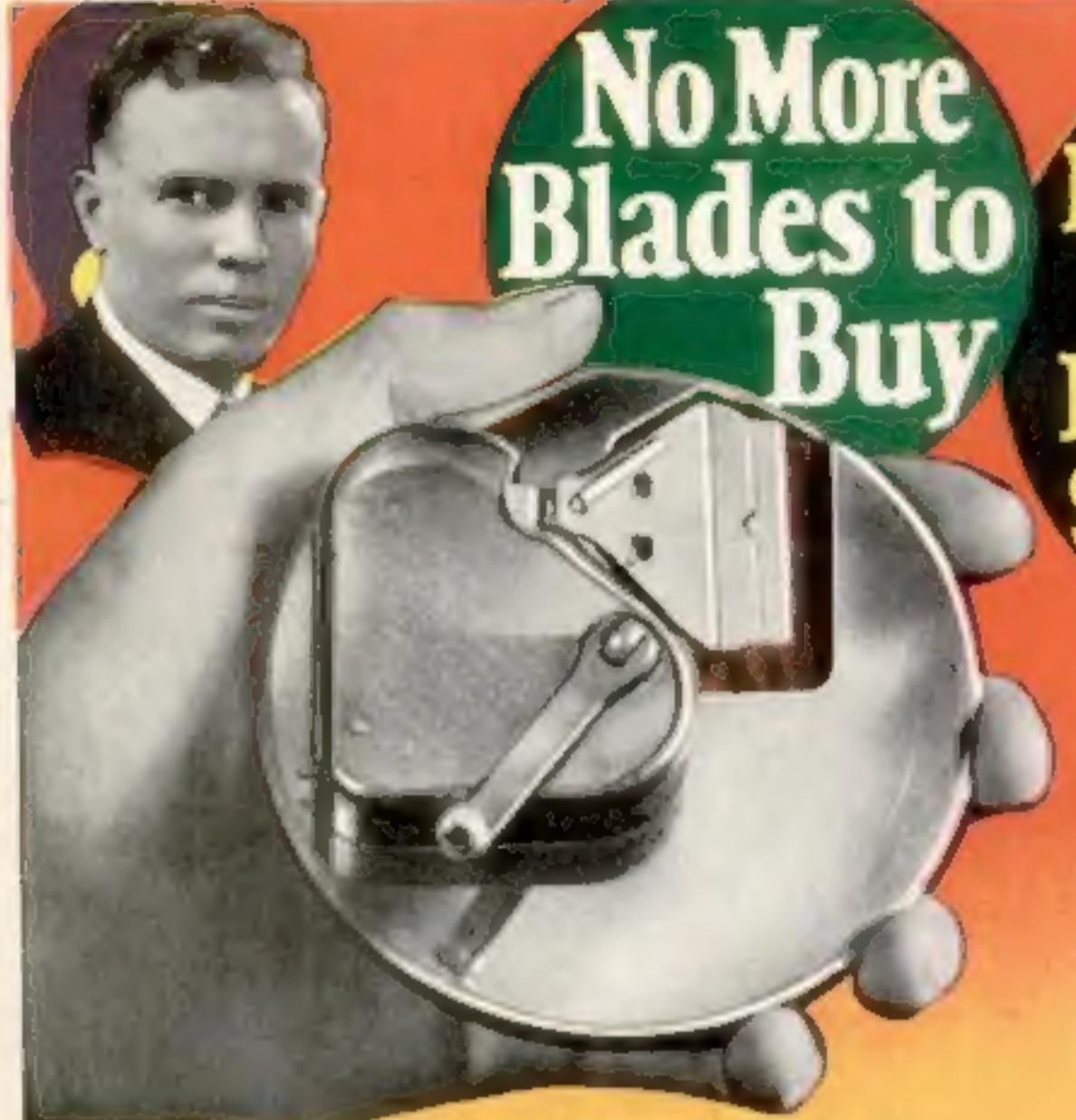
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Amazing Invention Revolutionizes Shaving

THINK of it! 365 keen, cool shaves a year from the same blade! That's what the revolutionary invention of a St. Louis man is doing for American shavers everywhere!

KRISS-KROSS marks the beginning of a new era in shaving comfort and economy. Its performance is so sensational that it seems hardly fair to call it a stropper. Rather it is a super stropper or blade-revolutionizer! Almost literally, it makes a new blade out of an old one every day. No longer do you find that your blades "die" after five or six shaves. KRISS-KROSS "brings 'em to life" a surprising way, week after week and month after month—and endows them with a keenness that they never possessed when brand-new! Actually—you can take a blade right out of a fresh package and improve it almost 100% in seven seconds with KRISS-KROSS! No wonder experts pronounce it one of the greatest inventions ever patented!

Magic Diagonal Stroke

Until you've seen KRISS-KROSS fitted its sturdy, cushioned smoothness into the palm of your hand and tested its amazing keenness yourself, you'll never know how amazing it really is! It employs the famous diagonal stroke, sure as a master hairdresser. Never before has anyone captured the secret of reproducing it automatically. Eight Tuck leather grooves do the trick in 11 seconds with a precision it takes a master hairdresser years to attain.

But that's not all. KRISS-KROSS embodies still another feature that has hitherto baffled mechanical reproduction. It starts from heavy to light. It's absolutely unique the way the strokes start with strong pressure and grow

faster and lighter until an adjustable, automatic jet fits up and notifies you that your blade is ready—ready with the keenest cutting edge that steel can take!

Fits All Blades

KRISS-KROSS produces unbelievable sharpness and prolongs the life of any razor blade for months and even years. Fits all brands and makes except Durban. Eliminates 90% of shaving cuts and ends all bother about remembering to buy new blades! No more "tinkering" and experimenting with dull ones, either! No more ringing and smarting that has to be relieved with money lotions and harsh astringents. KRISS-KROSS solves your blade problem for all time and gives you keen, soft-smooth shave forever—the kind you've only dreamed of until now!



3-Way Razor Free

To Every User—More astonishing name you ever saw. Ready 3 razors to use. Adjustable to any shaving position. Novel feature reduces beard irritation 45%. Nothing like it ever before. To send you one FREE in exchange KRISS-KROSS stropper.

Sensational Offer

And now for my surprising offer. To introduce KRISS-KROSS to those who have not yet seen it, I am giving with it Free a new kind of razor. Possesses remarkable features. Instantly adjustable to any shaving position. A dip of the finger makes it CO. To shave (CO straight cold stroke; or DI diagonal new way). Gives a sliding instead of pulling stroke. Simply slips right through the toughest crop of whiskers and leaves your face satin-smooth and cool. Made of Ruthless metal. All one connected piece—notting to assemble or screw up, comes with a special-prepared blade and is entirely unlike anything you ever saw before!

Send Coupon To-Day!

Send for details and information on this surprising new KRISS-KROSS invention today. See for yourself exactly how amazing and important they are. Read the amazing power of revolutionized shave. Write to: Rhodes Mfg. Co., Dept. B-241, 1415 Pendleton Ave., St. Louis, Mo. (No charge.)

Agents!

Make excellent money with KRISS-KROSS. FREE offers better power profits amazingly. H. King made \$100 in one day. N. C. Paine made \$100 in 3 days! Others average \$100 and up to \$700 a month! Spare-time workers, office and factory men make up to \$6 and \$12 extra a day showing KRISS-KROSS to friends and fellow employees. S. Kentala made \$100 extra just working evenings & weeks. Get details at once. Check bottom of coupon and mail it today!

Rhodes Mfg. Co., Dept. B-241,
1415 Pendleton Ave., St. Louis, Mo.
Without obligation, please send me illustrated description and full details of your special introductory offer on KRISS-KROSS super-stropper and FREE 3-way razor.

Name _____

Address _____

City _____ State _____ Grade _____

I, _____, check here if interested in making money as authorized KRISS-KROSS representative.

Rhodes

KRISS KROSS

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Largest Manufacturers of Mechanical Stroppers in the World